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A LIFE HISTORY STUDY OF THE CALIFORNIA QUAIL, WITH RECOMMENDATIONS FOR ITS CONSERVATION AND MANAGEMENT

By E. LOWELL SUMNER, JR.

(*Concluded from* CALIFORNIA FISH AND GAME, Volume 21, Number 3, July, 1935, pp. 167–256.)

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INTRODUCTION

Throughout most of California, quail are not nearly as abundant now as during the early days of settlement, or even fifty years ago. Not nature, but man alone, has been responsible for this decrease, either directly, as in the earlier days by market hunting, or indirectly, as today, by equally deadly agricultural practices which destroy quail habitat.

Causes for Quail Decrease. The chief causes for the decrease of California quail may be listed as follows:

1. Overhunting.
2. Destruction of food and cover by:
   a. Clean farming;
   b. Overgrazing;
   c. Fire control.
3. Exclusive use by man of water sources.

These causes are listed approximately in order of decreasing importance. However, since habitat conditions differ widely in different parts of the state, the relative importance of the factors enumerated varies according to the locality, and some may even be absent. For example, in the Santa Cruz Mountains, where the present study centered, the relative order of the factors seems to be 2b, 1, while in the western part of Riverside County the order is probably 1, 3.

General Applicability of Recommendations. The recommendations here outlined have for their chief source the life history study made of the quail of the Santa Cruz Mountains, San Mateo County, as covered in Part I. In regions where habitat conditions are markedly different from those of San Mateo County it is possible that problems may arise which are not covered by any of the recommendations. Moreover, our knowledge of quail management in general is still in its infancy, and that of the California species almost entirely undeveloped, so that a great deal of experimenting still lies ahead. Nevertheless, if the principles are followed which underlie the management suggestions given below, a marked increase in the number of quail will, it is believed, usually take place.

In view of the program for establishing a statewide system of quail refuges, which has been undertaken by the Division of Fish and Game (Welch, 1932; True, 1933*a*), the present interest in developing methods for the conservation and management of quail is especially timely. The ultimate goal should be to evolve a management technique for each major type of habitat in California, comparable to the techniques which are being worked out for the bobwhite of the eastern states by Stoddard (1932, 1933), Leopold (1933), and Errington (1931, 1933*c*, 1934).

General Requirements of Quail. Reduced to their simplest terms, the requirements of quail are as follows:

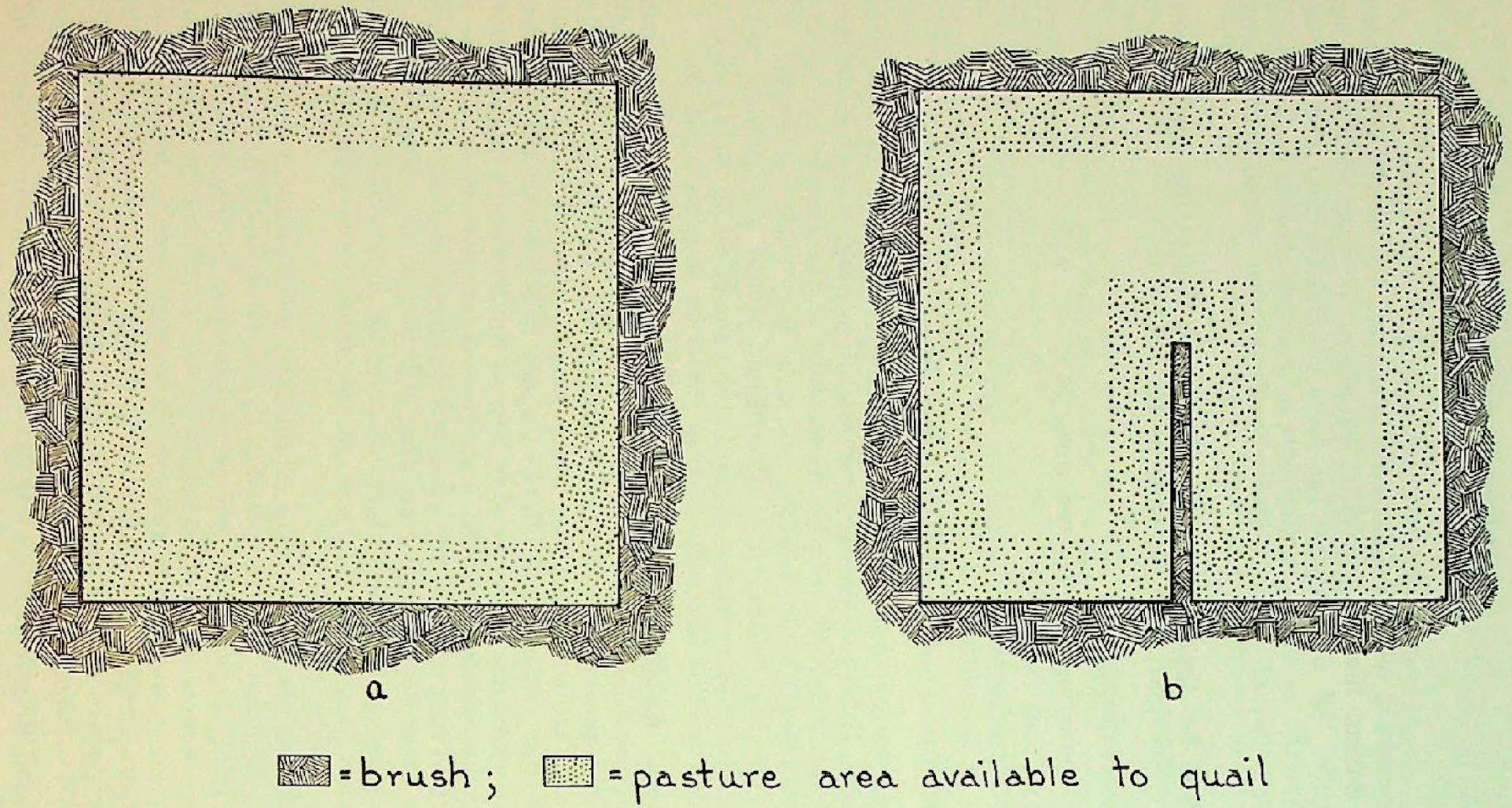

FIG. 1. Area in four-acre pasture available as food for quail.
a. Brushy cover only along edges; area of food available for quail only 38 per cent of entire pasture.
b. A ten-foot brushy strip extends to center of pasture; area of food available for quail now 50 per cent of entire pasture.

1. Cover—purpose, protection from enemies; includes:
   a. Nesting places;
   b. Roosting places;
   c. Resting places during daytime.
2. Food—mostly obtained close to, but not *in* cover.
3. Water.

Just *how* these requirements may be furnished, and how existing deficiencies may be corrected in any given locality, constitutes the problem of quail management, and will be treated in the pages to follow.

COVER REQUIREMENTS OF QUAIL

Topography. Thanks to a great inherent adaptability of quail on this score, topography of the land is not in itself an important factor in their environment, at least up to about 4000 feet altitude. Provided adequate food, cover and water are present, the California quail may be found from the Pacific coastal fog belt to the edge of the desert in eastern California. Steep hillsides and flat stream bottoms are frequented by them with equal readiness.

The Unsuitability of Large Open Spaces; Improvement Principles. The life of quail is inextricably bound up with cover. Regardless of whether or not enemies are present, the birds leave its vicinity only rarely or for but brief intervals. When it becomes necessary for them to venture into the open, either to reach another patch of cover or to search for food after the supply close to cover has been exhausted, they are noticeably ill at ease and ready to run or fly back to the brush at the first alarm. If it were possible by reason of an inexhaustible food supply for the birds to remain always in cover, the winter mortality rate aside from hunting would approach zero. Under natural conditions, the food supply furnished by the cover itself is exceedingly limited, as will be shown below; for this reason quail must do nearly all their foraging on the open ground which produces the weed seeds and grasses upon which they chiefly depend. And it is when they are in the open, away from cover, that they suffer their heaviest losses from natural enemies.

Although exceptions are sometimes observed, there is a fairly definite cruising radius from cover of about fifty feet, beyond which the birds usually will not venture even when pressed by hunger, so great is their aversion to open places. This aversion sets a definite limit to the territory available to them and operates even when enemies are scarce or absent. For example, if we have a square-shaped, quail-food-bearing pasture of four acres surrounded by brush, the total area which can be used by quail is comprised by a strip about 50 feet in width running along the four sides of the pasture (Fig. 1, a). Computation shows this area available to quail to be only 38 per cent of the total area of the pasture. But suppose that we plant, or allow to remain, a strip of cover ten feet wide and extending from one edge out to the center of the pasture (Fig. 1, b). By doing this we shall sacrifice 2 per cent of the total area of the pasture, but the area available for quail will have been increased to 50 per cent of the total, which is a gain for the quail of 12 per cent. As mentioned below in discussing erosion

control, a gully which furnishes little pasturage, but which is a source of costly erosion if unchecked, may be allowed to grow up to brush, thus serving a double purpose while entailing no real loss of usable pasture land.

The Unsuitability of Large Areas of Dense Cover; Improvement Principles. Although a certain amount of dense cover is essential to quail, it can be a means of crowding the birds out of a given locality if it comes to occupy extensive tracts to the exclusion of all open land.

Fire Control a Probable Cause for Quail Decrease. It seems very likely that the policy followed by forestry officials of restricting the burning of brush areas has had an unfavorable influence upon quail in the foothill regions. According to old time residents in the Santa Cruz Mountains and elsewhere in California, fires were set on purpose every year, but these usually died out before running very far because the chaparral was of more open stand and lower in stature, and because the amount of inflammable material was much less than at present. Under conditions prevailing in those times a man could ride on horse-

FIG. 2. Los Trancos Canyon, Santa Cruz Mountains, representing an area largely unsuitable for quail. The woods are not only impenetrable to man and to livestock but also shut out the weeds and grasses upon which the quail depend for food. A few coveys live along the margins of the open areas visible in the distance.

back through a great deal of country which is now a dense, nearly foodless jungle. With the chaparral vegetation restricted, the native weeds and grasses, which constitute the chief item of food for quail, were correspondingly more abundant, whereas at present they have been largely choked out of such areas (Figs. 2–4). As pointed out by Storer (1932, pp. 3, 23), it is doubtless significant that since the foothill country has grown up to impenetrable brush, the deer which lived on the previously open slopes have moved down into agricultural lands and in many cases have inflicted serious damage upon crops. And it is probably also significant that the quail have dwindled or vanished entirely from these same areas.

Not only is the seed crop produced by chaparral plants much less abundant than that of the grasses and herbaceous weeds, but it appears to have distinctly less food value as well (pages 171, 180, Part I). The fact that chaparral seeds constitute only 4 per cent of the total food of

quail is a further indication of the subordinate importance of brushy cover as a food supply. On the other hand, the seeds of weeds and grasses, which constitute an enormous annual crop of high food value, amount to 58 per cent of the total food consumed. For this reason, a quail range almost wholly covered with an impassable stand of brush, while offering admirable protection to the birds, is seriously deficient in food materials.

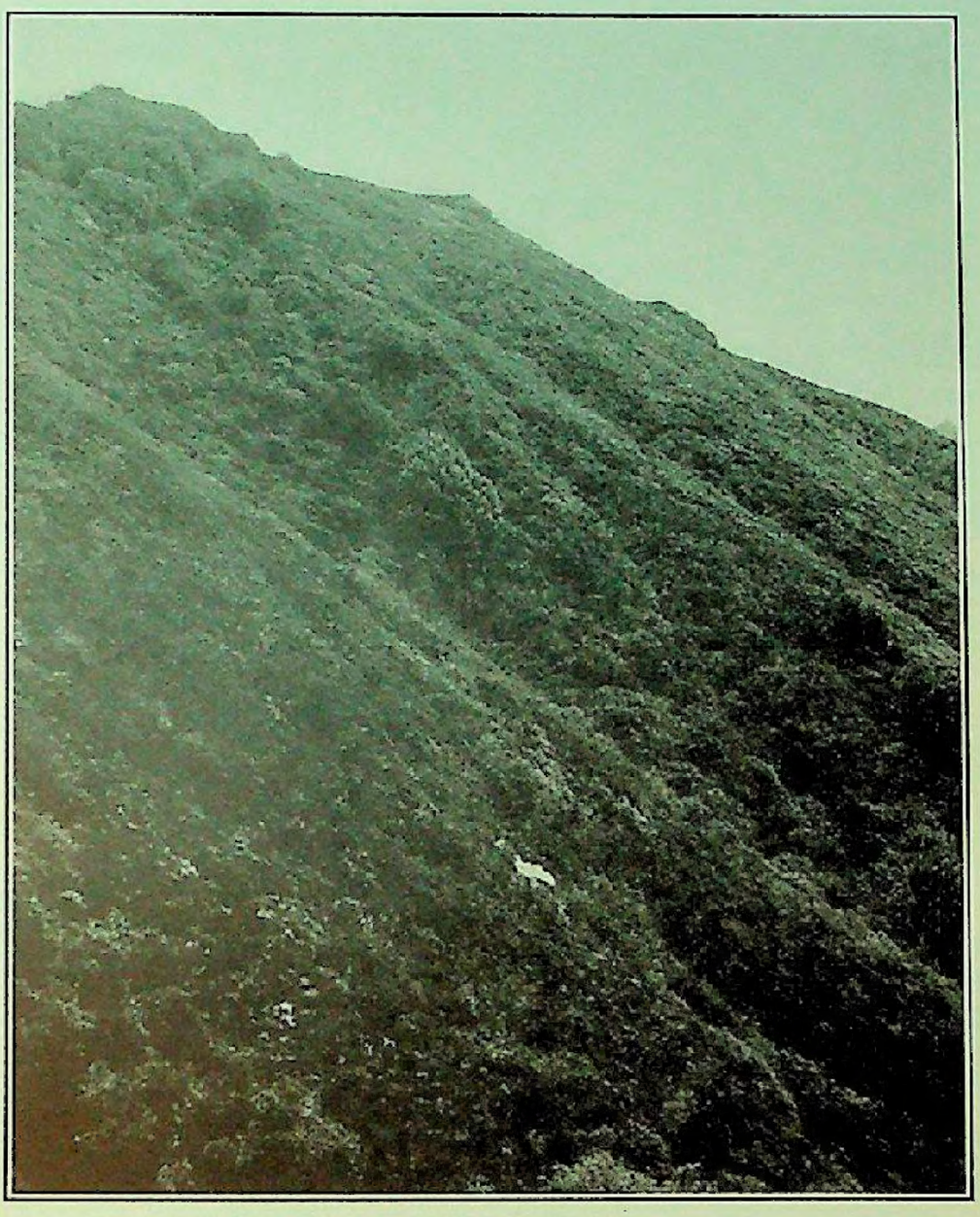

FIG. 3. Impenetrable stretch of chaparral at head of Peters Creek, Santa Cruz Mountains. Although this type of vegetation is now unsuitable for quail, the area was probably less dense, with frequent open spaces supporting quail food, in the early days before rigid fire control.

If lanes ten or more feet wide are cleared through brushland of the type described, a crop of food-bearing weeds and grasses will usually spring up where previously the range was foodless, thus allowing a greater number of quail to live upon the area (Figs. 5, 6). As mentioned below, such steps will also increase the total area available for nesting.

The Law of "Edges". The outline of general principles just given illustrates that quail, like other kinds of game, require an *interspersion*

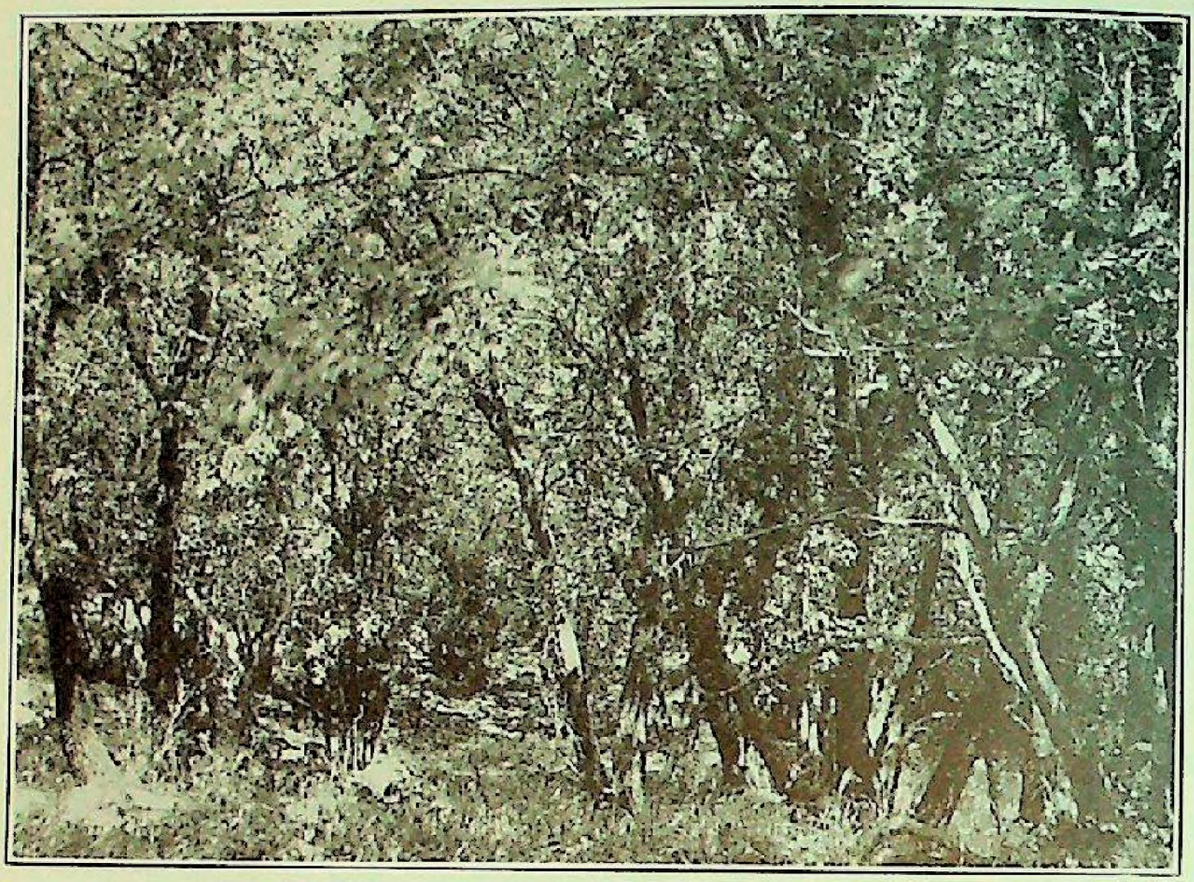

FIG. 4. Los Trancos Canyon, Santa Cruz Mountains. This dense stand of black oak woods is unsuitable for quail because ground cover and food-bearing weeds can not grow here. The trees have sprouted from stumps left when the area was cut over for firewood fifteen years ago. Quail could live here if the area were cut over once more. (Compare with Fig. 17.)

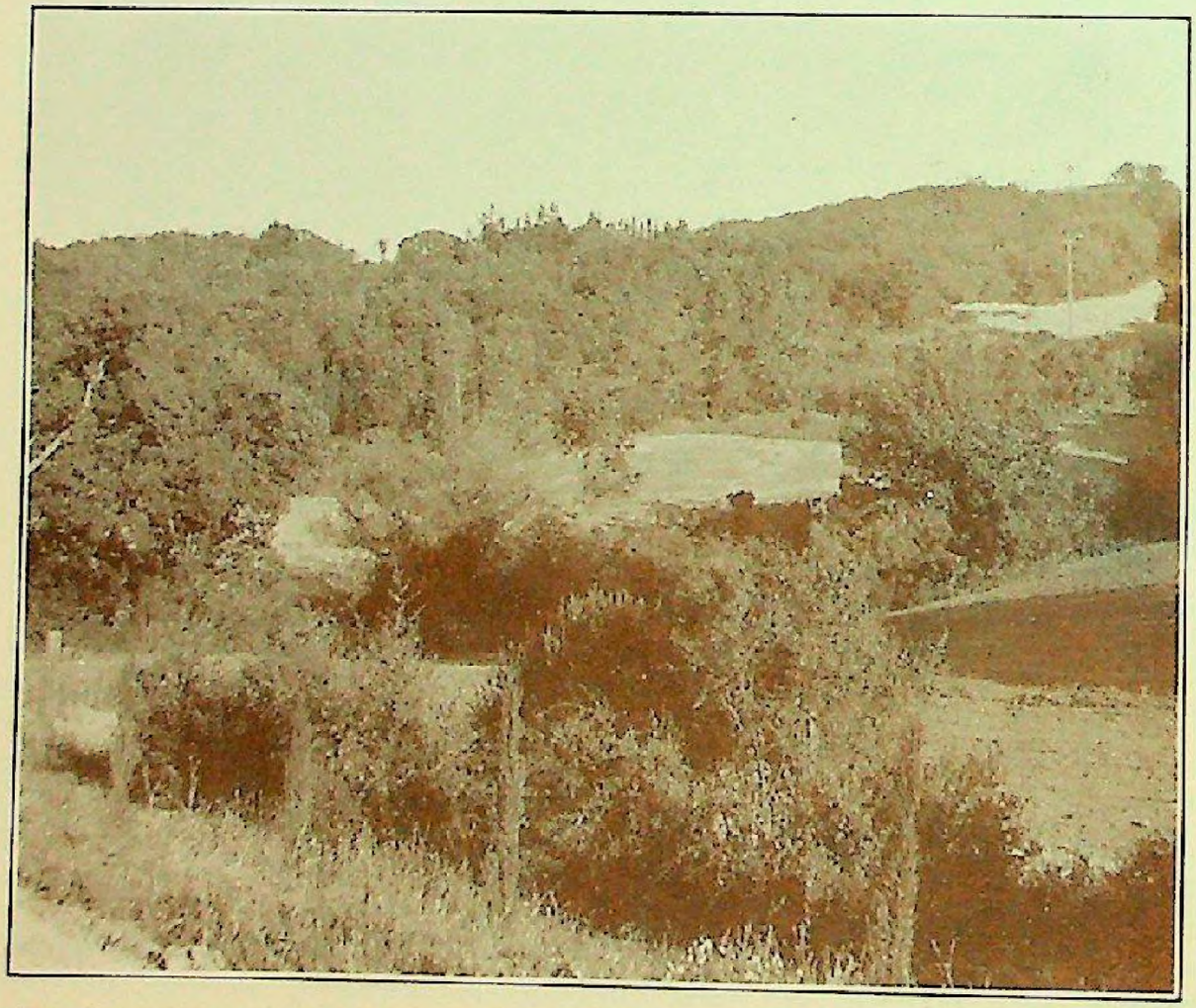

FIG. 5. Interspersion of farmed land and cover on Rolph Ranch, Santa Cruz Mountains. Note food-bearing weeds at edge of all cover. This area supports a large number of quail.

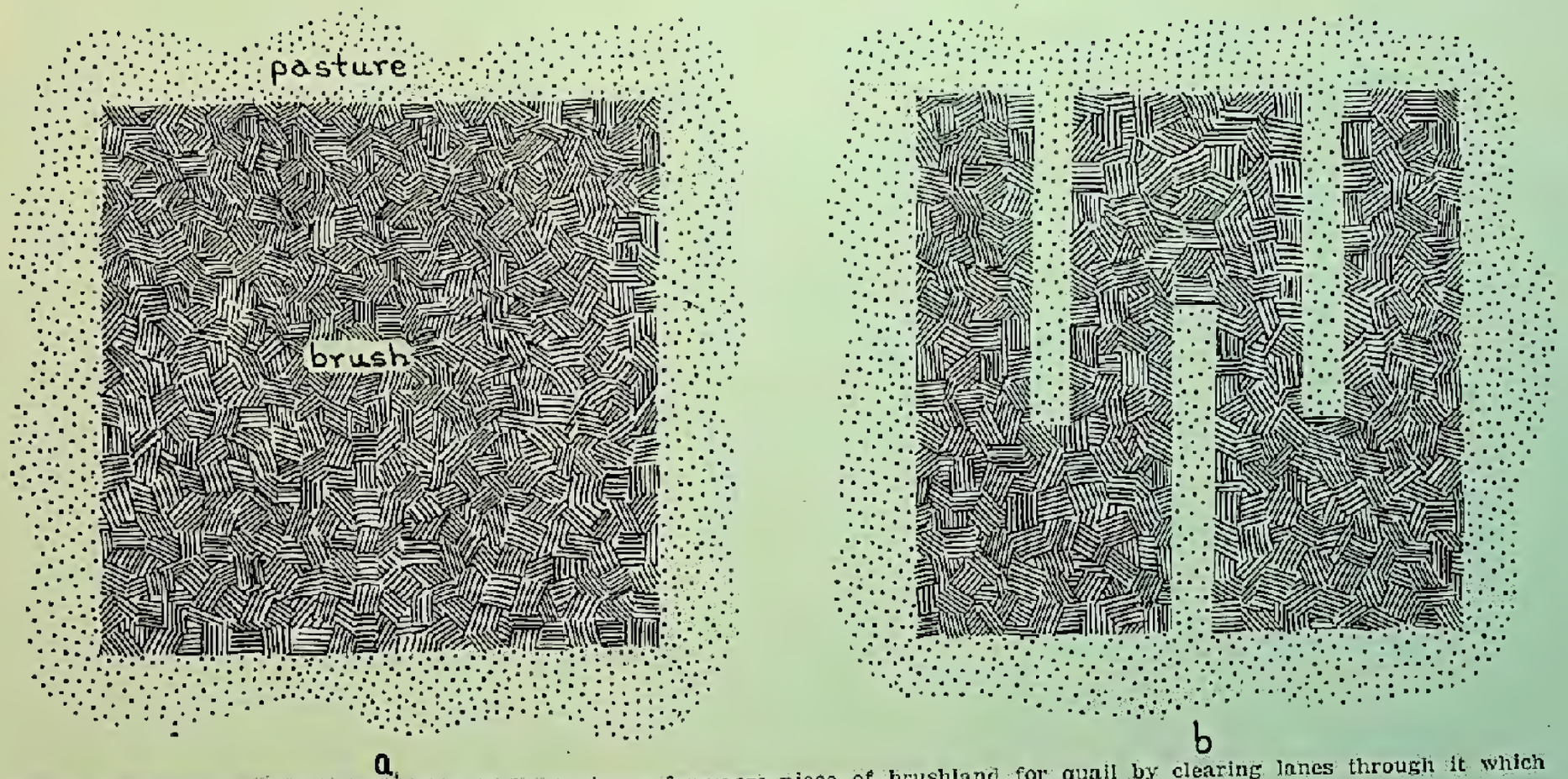

FIG. 6. Diagram illustrating method of improving a four-acre piece of brushland for quail by clearing lanes through it which will grow up to food-bearing weeds and grasses as described in the text.

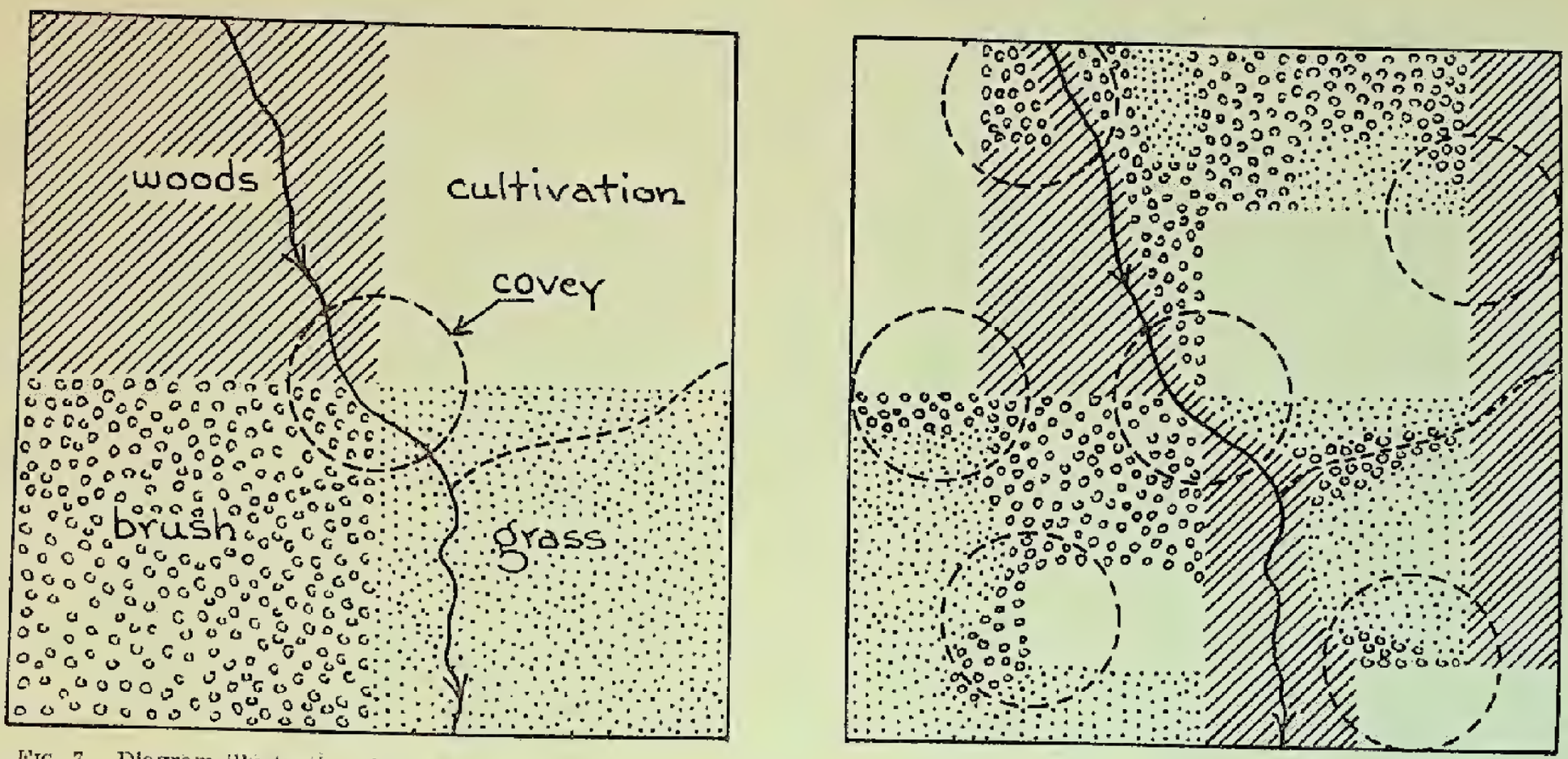

FIG. 7. Diagram illustrating the relation between the number of quail coveys which a given piece of land can support and the total number of "edges" present. (From "Game Management," courtesy of Aldo Leopold and Charles Scribner's Sons.)
a. Few "edges" (one covey).
b. Many "edges" (six coveys).
(Same vegetational types and same total area of each.)

of food and cover, and spend most of their lives along the *edges* between these two types of environment. Indeed, the number of quail that a given piece of land will support seems to be definitely correlated with the number of miles of edges present. Hence if we can increase the total amount of edge land, we shall have increased the number of quail present, other factors remaining unchanged. An excellent diagrammatic illustration of this principle by Leopold (1933, p. 130) is here reproduced (Fig. 7). In "Case a" there are two miles of edge present, with a potential of one covey; in "Case b," with the same total area of each type of land, there are ten miles of edge, with a potential of six coveys. For this reason an acre of fence row or hedge, consisting, so to speak, entirely of edges, usually has more game (and songbirds also) than many acres of unbroken woods, or wheat, or corn (Figs. 2–4).

Clean Farming in Relation to Depletion of Quail and Soil Erosion. A potent cause of the decrease of quail in modern times is the practice of removing all weeds and other vegetation not of direct visible use to man from fence rows, roadsides and unused corners about the farm. (Figs. 8-10.) The removal of weeds and brush from such places is occasionally necessary in order to reduce the fire hazard, but this is usually the case only along main highways. The practice is less defensible when applied to agricultural lands not close to highways, although it is advocated by some agriculture authorities on the grounds that such vegetation constitutes a refuge for insect pests as well as promoting the spread of undesirable weeds. The removal of this vegetation, which constitutes an almost 100 per cent edge type of environ-

FIG. 8. Food-bearing weeds in foreground (light), with tall, dense stand of Spanish broom (*Spartium junceum*), which is also of value for food, behind (the main central mass of cover). This jungle of cover provided a year-round refuge for a quail covey.

ment, spells the doom over large areas not only of quail but of certain insectivorous songbirds as well, by removing all of the available shelter.

As a matter of fact, the desirability of this policy appears from recent findings to be less than originally believed. For example, it has been doubted whether leaving weeds for game "contaminates" the soil, the probability being that weed seeds are present in *all* soils, their growth being determined by the physical condition of the soil for germination, and the presence or absence of other competing plants.

FIG. 9. A result of clean farming. Same area as in Fig. 8, after removal of weeds and Spanish broom. The quail covey was obliged to leave the neighborhood. Note erosion gully in center of picture.

In some recent instances it has been shown that fence row cover has benefited agriculture by harboring songbirds and also predatory insects which serve as a check on insect pests. For example, Fluke (1929, p. 39) found that the pea aphid, which is a serious pest to commercial pea growers, was less numerous in the vicinity of game cover such as ungrazed wood lots because such places harbored the syrphid flies and lady beetles which are the natural enemies of the pea aphid, and which kept it in check over a radius of one-eighth to one-fourth mile around each ungrazed woodlot.

A result of clean farming which is even more significant is its tendency to increase soil erosion (Fig. 10). Erosion has become a national problem of gravest importance, and has been estimated to affect from 75 to 90 per cent of all western range lands (Bennett, 1931, p. 358). The seriousness of the approaching erosion crisis has been pointed out by the Land Planning Committee of the National Resources Board (1935, p. 161).

FIG. 10. An example of clean farming, with its attendant ill consequences represented by erosion, in the Santa Cruz Mountains. This gullying resulted from a single rain. The area is devoid of quail.

Methods of Erosion Control of Benefit to Quail. The simplest and least expensive method of checking erosion, which is also nature's method, is to allow as much as possible of the natural vegetation to remain on the land (Fig. 11). Where the type of crop permits, as in the case of orchard lands, Weir (1932, p. 26) recommends that untilled grassy strips be left in the tree rows (Fig. 12). Such strips provide both food and cover for quail, thus rendering available to them large areas in regions where natural enemies are scarce but which otherwise would be more barren than a desert from the standpoint of the birds.

Drainage ditches for carrying the excess water from lands subject to erosion should either be lined with rock, which is laborious and expensive, or allowed to grow up thickly with vegetation. In regions where bench terraces are used to check erosion, the outer slope or riser may be allowed to grow up to weeds and grasses in order to maintain its contour (Fig. 13). Where this is done, the quail will again receive a twofold benefit.

The formation of deep gullies (Fig. 14), which constitutes one of the chief sources of erosion, may be controlled by dams of rocks and piled brush, the brush often being obtainable from too-brushy areas of the sort described above (page 280). Sometimes the gullies may be checked by seeding to native grasses, or by planting the sides and bot-

FIG. 11. An unused corner of a farm, which has been allowed to grow up to weeds (newly planted vegetable garden visible in upper left). Excellent cover for quail is present along the fence, while the live oak trees in the background furnish roosting sites. A brood of young was flushed from this spot at the time the photograph was taken.

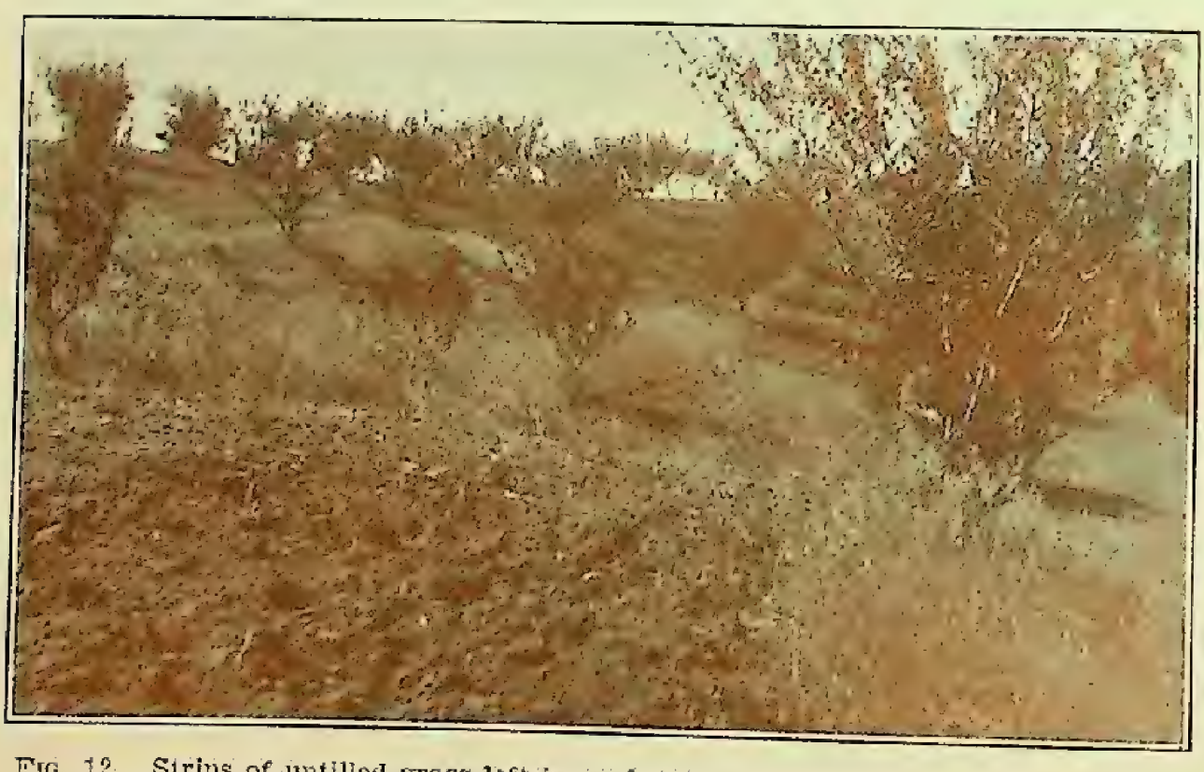

FIG. 12. Strips of untilled grass left in, or between, rows of orchard trees will not only check soil erosion but will also provide food and cover for quail in areas which would otherwise be as barren as a desert from the point of view of the birds. (Photograph courtesy of Walter W. Weir.)

FIG. 13. In regions where bench terraces are used to check erosion, the outer slope or riser may be allowed to grow up to weeds and grasses in order to maintain its contour. This will also provide food and cover for quail. (Photograph courtesy of Walter W. Weir.)

FIG. 14. Typical gully caused by overgrazing. Due to the lack of sufficient plant cover to bind the soil, such drainage channels, which under natural conditions are of insignificant size, deepen and widen, and also work gradually to the top of the drainage area. Seeding to native grasses, fencing and installation of soil-saving dams, check and ultimately fill up such gullies; shelter is also furnished for quail which would not otherwise be present. The area shown here lies in the heart of what was a famous quail country before it was subjected to fifty years of overgrazing.

toms with trees and shrubs which should be selected with the needs of quail and other birds in mind (see page 315 for list of suitable species).

Overgrazing as a Cause for Quail Decrease; Control Methods. The life history study carried on in the Santa Cruz Mountain region indicated that one of the most important causes of quail decrease on many range lands is overgrazing by live stock. The direct damage which such stock does by feeding and trampling upon quail nesting cover is easily seen and often commented upon. In San Diego County, for example, cattle ate off the grass clumps in which quail nests were located, to the very ground, so that the nests were entirely exposed and the eggs visible for a distance of many feet.

Fencing Brush Patches Used for Nesting. One remedy for the destruction of nesting cover is to put a three-strand barbed wire fence around islands of brush or small clumps of trees offering ground cover. Such patches of brush or trees provide only a trifling amount of forage for stock, anyway, so that their use may well be diverted to building up a supply of birds. When erecting such fences a strip of grass about a yard wide should be included along the edge of the brush. Since quail usually place their nests near the edges of brush clumps, this strip of grass will better protect the birds from the sight of ground prowlers. In addition, it will furnish an easily accessible food supply during the time that the young are very small.

Fencing Edges of Gullies. The edges of gullies which have been caused by erosion should always be fenced off from live stock as a first step in reclamation because the animals constantly tend to cave in the banks while foraging, especially in the spring when the new vegetation springs up in the gullies before it appears elsewhere. Gullies which are not fenced off slowly work upslope, encroaching farther upon the usable land with each passing year (Fig. 14).

FOOD REQUIREMENTS OF QUAIL

Adverse Indirect Effects of Overgrazing. Less easily seen than the direct effects of trampling upon nesting cover, but of even more importance to quail both as to prevalence and ill consequences, is the wholesale destruction of the natural food supply of a range by overgrazing. Under such conditions the weeds and grasses which grow along the edges of woods and brushlands are consumed by the stock early in the season. As a result, the quail find themselves without food by the middle of winter, which is the season of greatest shortage and hence one of the most difficult periods of the entire year. This situation is unfortunately quite prevalent in the Santa Cruz Mountains, as well as in many other parts of California. Not the least insidious feature is that often the shortage of quail foods in such regions is not readily detected. The casual observer, seeing plenty of pasture land interspersed with thick woods and brushy areas (Fig. 8, Part I), may conclude that conditions for quail are satisfactory; and it is only when one walks along the "edge" land and attempts to count the remnant of seed-bearing weeds that one realizes the true state of affairs. Frequently the bare, denuded pasture extends right up to the wall of brush

or woods, with no weedy margin left at all, and frequently not even any usable cover (Fig. 15).

Overgrazing is scarcely defensible under any circumstances, since it leads to decreased productivity of the land, erosion, and loss of water storage. Where this is realized and the practice abandoned, an increase in the number of quail may be expected.

Direct Relation of Number of Quail to Carrying Capacity of the Range. It must be strongly emphasized that where the food supply for quail is slight, the number of birds which can stay on the land is strictly limited by this factor, regardless of how many additional quail may be liberated there to "build up the stock," and regardless of how many predatory birds or mammals are killed to "protect" the quail. For example, if there is a total of only one-half mile of food-bearing edge cover on a certain overgrazed pasture which supports a covey of 20 quail, it is worse than futile to liberate more quail there without first increasing the food supply by a proportional amount. Indiscriminate liberation of quail would have the same effect upon the existing population (unless heavy shooting had recently taken place) as the dumping of a trainload of unemployed people would have upon a depression-ridden city whose inhabitants were until that time just able to get along; in both cases starvation conditions would result. Just such a liberation of quail was made by the writer for experimental purposes in an area which supported a resident covey of about 30 birds and which looked favorable superficially, although it was actually low in quail food, due to heavy overgrazing (Fig. 15). Ninety-seven new birds were liberated there, yet three weeks later less than the original 30 could be found. A similar result followed the liberation of 152 banded quail in the rather closely grazed hills of Napa County; many of these latter birds were eventually traced to nearby farm lands where the supply of weed food was more abundant.

Inadequacy of Quail Range Resulting in Loss of Weight. Errington has shown (1931, p. 8; 1933c, pp. 19, 21, 27) that in the case of the bobwhite of Wisconsin, inadequacy of winter range results in a significant loss of weight due to starvation, which in turn reflects weakness and an inability to survive the winter season. Birds weighing 60 grams (2 oz.) less than the winter normal (200 grams; 7 oz.) still had some chance of survival if man-supplied food became available; birds more than 60 grams underweight were practically doomed. In the vicinity of San Francisco Bay, California, where the winter climate is far less rigorous than that of Wisconsin, the sudden crisis in food conditions brought about by cold weather and snow is usually absent. Nevertheless, the gradual process of food depletion goes on day after day in the latter region just as surely and with the same fatal results as in Wisconsin.

In this connection it may be significant that during the months of November and December, which represent only the beginning of the winter season, the weights of 33 California quail from a ranch where grazing was light averaged 191.2 grams (6.8 oz.), whereas the weights of 45 quail from another ranch where grazing was moderately heavy averaged only 185.3 grams (6.5 oz.). Further indication of the significance of this difference is given by the fact that the stomachs of 14 quail

collected from the slightly grazed area during the same months contained 45 species of food plants, while the stomachs of 28 birds from the rather heavily grazed area contained only 19 species of food plants (page 171, Part I). Future experience may show that a seasonal weight chart based on optimum conditions (page 248, Part I) can be used as an accurate check upon the favorableness or unfavorableness of a given locality by comparing weights of birds collected there with the value shown by the chart for the same time of year.

FIG. 15. "Edge" land on a heavily overgrazed pasture in the Santa Cruz Mountains. Because the photograph was taken in early summer, some food for quail is visible, but the amount is far below normal, and it will not last long. The denuded pasture extends to the very edge of the woods, with no brushy cover present, so that the little food present is largely unavailable to the birds.

Deleterious Effects of Loss of Weight. Marked loss of weight through scarcity of food has a deleterious effect upon game birds even when not fatal. Diseases and parasites which may be unobserved and of minor significance under normal conditions, manifest themselves and jump forward in their rank of importance as soon as the vitality and normal resistance of the birds are lowered by unfavorable conditions such as prolonged severe weather or extreme scarcity of food.

The effects of scanty food and loss of weight upon quail may be estimated by observing the effects of the same conditions on cattle. Hart and Guilbert (1928, p. 10) have pointed out that "The condition of nutrition of animals has an important bearing on the development of estrum. It has long been observed, for example, in range cattle that, during unfavorable years when feed is poor and weather conditions bad, causing mature nonpregnant cows to become very thin, no estrum is noticed until feed conditions are such that the animals begin

to improve physically even though many months are required for this change to occur . . . Under such conditions it will take a considerable part of [a subsequent] good year for the animals to get back into a sufficiently high plane of nutrition for the normal development of the estrous cycle followed by breeding . . .". Undoubtedly the observed failure of quail to breed during poor years (Bendire, 1892, p. 27; Newsome, 1927, p. 67; McLean, 1930, p. 18) rests upon a similar basis, and probably a locally insufficient food supply has the same effect even in years which are normal for the rest of the country. Even when conditions of nutrition are not so poor as entirely to prevent breeding, they almost certainly result in smaller clutches of eggs, as in domestic poultry under the same conditions.

FIG. 16. Weed growth which appeared in the first spring after cutting over the heavily wooded area shown in Fig. 4. Although the year was unusually dry and no disking was done, enough food is present to support a small covey of quail.

In consideration of these facts, a benefit would result if persons interested in building up a quail supply would rely more for their ideas as to range capacity upon what is known of food requirements, and factors influencing percentage of reproduction, of range cattle. Both quail and cattle get their food largely from the same places, being, in fact, competitors; neither of them can thrive or even survive in a region where food is inadequate; neither of them can be successfully turned loose in indefinite numbers upon a range which can support only a small number of those placed there. Just as the stockman gauges the carrying capacity of a range for cattle, so should the game manager judge the capacity of a range for quail, and according to the

same principles, for cattle and quail are both crops produced by the land. The writer has come to the conclusion that in many regions where quail were formerly abundant, but are now reported as slowly dying out in spite of protection from hunting, the birds are vanishing because of a gradual depletion of the food supply brought about by overgrazing, this food depletion operating not only to destroy surplus individuals by forcing them into the open in search of food so that they are picked up by enemies, but operating also so as to reduce the average number of young produced annually by each surviving female, as in live stock under similar conditions.

ENCOURAGEMENT OF NATURAL FOOD AND COVER

Maintenance of Lanes Cut Through Dense Brush. As previously mentioned (page 281), large areas of dense brush offering scant food may be made productive by clearing lanes ten or more feet wide through them. Cutting the brush is less expensive than pulling it out by the roots, but in the former case the roots will sprout again each year and will also interfere with disking. If the brush is cut instead of being pulled, the sprouts may often supply a beneficial amount of cover on the lanes, but they should be cut back again each year or two about midsummer to prevent them from gradually crowding out the weed crop. Sometimes such sprouts can be controlled and ultimate clearing of the land attained by carefully regulated grazing.

Disking to Stimulate Growth of Natural Foods. Although not absolutely necessary (Fig. 16), it is recommended where labor and expense are not prohibitive that lanes cleared through brush be disked each season. This treatment, by breaking up the hardened soil and checking the growth of certain grasses which tend to grow up fast and choke out other more desirable weed types, greatly stimulates the growth of weeds producing quail food. Of course plowing is still better, and is to be recommended where the expense is justified, as in localities where quail are the main crop.

Limited observations made by the writer in the Santa Cruz Mountains indicated that when cultivation was done in the spring the resulting crop was chiefly wild oats (*Avena fatua*) and various other wild grasses (*Bromus*, Fig. 43; *Lolium*, Fig. 44; *Hordeum*), which with a sprinkling of weeds such as *Anthemis*, furnished altogether 10 per cent of the local quail food. When cultivation was done in late summer the chief crop was tarweed (*Hemizonia congesta*, Figs. 31; 10, Part I), which amounted to only 1.29 per cent of the local food supply (page 173, Part I). The open nature of the tarweed growth furnished much better ground cover for the birds than did the dense stands of grasses, however. Further experiments should be carried on in this direction; at present the most that can safely be said is that disking should *not* be carried on from about the first week in March, representing the earliest commencement of the nesting season, until about the first week of August, when the young are usually large enough easily to keep out of the way of the disk harrow.

Treatment of Woodlands. In that part of the Santa Cruz Mountains where the present study was made more than two-thirds of the

total area was occupied by dense woodlands of a type (Fig. 17) which is largely unsuited to quail by reason of its scanty food supply and also because of a natural reluctance on the part of the birds to penetrate far onto its deeply, shady, barren floor. Much of this woodland is commercially valuable as a source of firewood (Fig. 18) and has been cut over in bygone years for this purpose, the stumps (mostly live oak and black oak) being left to sprout and form a new crop. The clearing of such woodlands greatly benefits quail for a number of years following the cutting, by permitting an extensive crop of weeds to spring up on

FIG. 17. Area in Santa Cruz Mountains prior to being cut over for firewood. At the time the photograph was taken it was unsuitable for quail. (Compare with Fig. 19.)

ground that was formerly barren and shady (Figs. 16, 19). Eventually, however, unless certain lanes are kept clear for the use of the quail, the cut-over area grows up to woods once more, crowding the weeds and the birds out.

In places where the landowner does not wish to sacrifice the scenic value of the woodlands to commercial profit, it is still possible to cut out trees and undergrowth along previously determined strips, the resulting wood supply being of value for home consumption.

Regulated clearing of this type would often render the land more attractive scenically, or at least more available, for under present conditions thousands of acres extending on every hand are impassable to a man on horseback and all but inpenetrable even to persons on foot (Figs. 2-4).

The building of roads through this sort of country benefits quail in the same manner due to the establishment of a crop of roadside weeds (Fig. 21), and possibly also by reason of the supply of grit furnished by the graveled road surfaces.

The Most Important Natural Foods of Quail. There is some local variation in the food items eaten by quail in California on account of

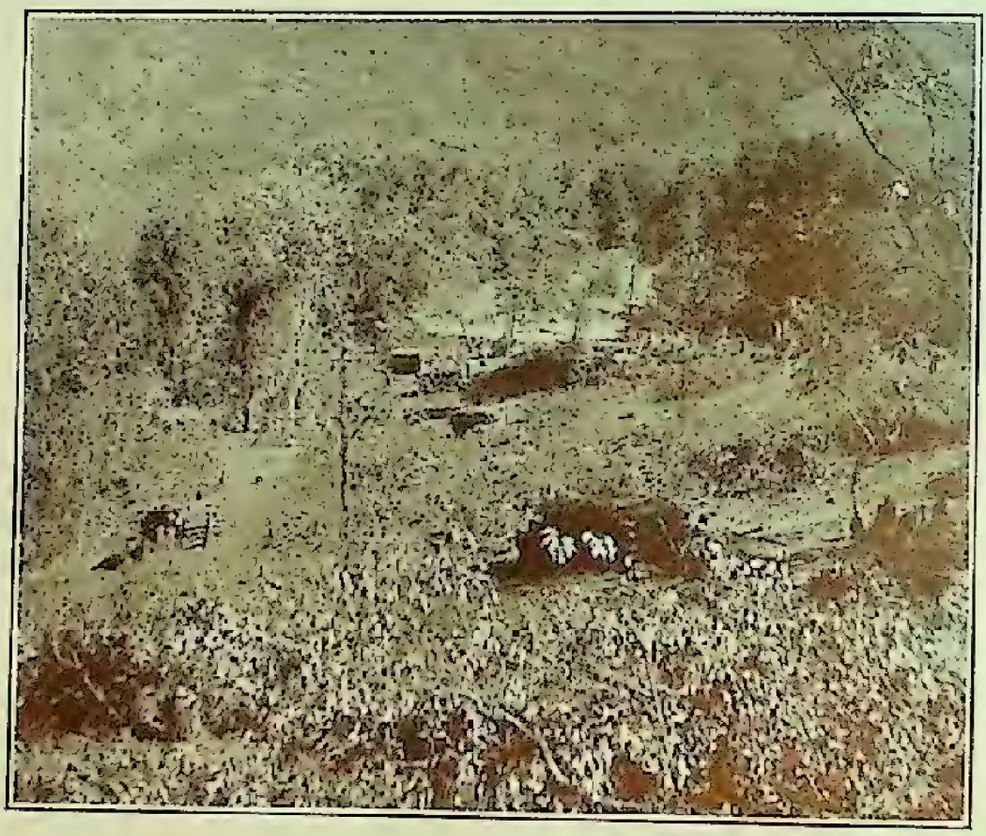

FIG. 18. Part of the area shown in Fig. 17, demonstrating the value of this type of country as a source of firewood.

differences in the distribution of the plants concerned. Some species such as the lupines occur almost everywhere that quail occur, while others such as the sumac (*Rhus laurina*) of southern California are decidedly restricted in range. The list of food plants given here is for the use of those who desire to encourage or protect the local food supply on areas devoted to quail, and for this reason includes only important species of reasonably wide distribution. For a complete enumeration of the food of California quail, with percentages of each consumed, see page 172, Part I, together with the lists of Judd (1905, p. 49), Beal (1910, p. 11), and McLean (1930, p. 32); the examination of stomachs from additional localities in California would doubtless somewhat increase the number of recorded food items.

FIG. 19. Area shown in Fig. 17 after removal of some of the tree growth for firewood. The area is now available for quail. (See also Fig. 16.)

FIG. 20. Fence entirely covered with climbing rose bushes, and bordered by a dense growth of food-bearing weeds. A fence of this sort makes an attractive inclosure for the family garden or for other grounds near dwellings, and also provides a sanctuary for song birds and quail. A large covey of the latter spent much of their time along this particular fence, and at least one brood of young was raised there.

FIG. 21. An ideal stand of food-bearing weeds, growing in a patch of waste land at the edge of a road which runs through rather dense brush and woods. The tall, dark weeds in the foreground are Dock (*Rumex* sp.). Quail lived in this area the year round.

FIG. 22. Bur Clover (*Medicago hispida*). The most important single food plant (14 per cent) in the diet of quail. Flowers small, yellow; burs armed with curved prickles.

LIST OF COMMON CALIFORNIA PLANTS IMPORTANT AS FOOD FOR QUAIL

(Distribution according to Jepson, 1925)

Bur clover (*Medicago hispida*), Fig. 22.
Vetch, all species (*Vicia*), Fig. 23.
Wild clover, all species (*Trifolium*), Fig. 24.
Lupine, small seeded species (*Lupinus*), Fig. 25.
Bird's-foot trefoil and deerweed, all species (*Lotus*), Fig. 26.
Thistles, apparently all species (*Centaurea*, Fig. 27; *Cirsium*; *Silybum*; *Sonchus*, Fig. 28).
Dandelions, all species (*Taraxacum*; *Agoseris*), Fig. 29.
Prickly lettuce (*Lactuca scariola*), Fig. 30.
Tarweeds, all species (*Hemizonia*, Fig. 10, Part I; 31; *Madia*, *Layia*, *Lagophylla*).
Mayweed (*Anthemis cotula*), Fig. 32.
Fuller's teasel (*Dipsacus fullonum*), Fig. 33.
Turkey mullein (*Eremocarpus setigerus*), Fig. 36.
Filaree, all species (*Erodium*), Fig. 35.
Pigweed, all species (*Chenopodium*).
Tumbleweed and rough pigweed (*Amaranthus graecizans*; and *A. retroflexus*) Fig. 34.
Mustards, all species (*Brassica*).
Wild radish (*Raphanus sativus*).
Shepherd's purse (*Capsella bursa-pastoris*), Fig. 37.
Chickweeds, all species (*Cerastium*, Fig. 38; *Stellaria*).
Wild geranium (*Geranium dissectum*), Fig. 39.
Miners' lettuce (*Montia perfoliata*), Fig. 40.
Red maids, all species (*Calandrinia*).
Red sorrel (*Rumex acetosella*), Fig. 41.
Dock, all species (*Rumex*), Figs. 21, 42.
Chess, species with small seeds (*Bromus*), Fig. 43.
Rye grass, all species (*Lolium*), Fig. 44.
Buttercup, all species (*Ranunculus*).
Buckthorn weed or fireweed, all species (*Amsinckia*), Fig. 45.
Pimpernel or Poor Man's Weatherglass (*Anagallis arvensis*), Fig. 46
Plantain, all species (*Plantago*), Fig. 47.
Sumac (*Rhus laurina*).
Poison oak (*Rhus diversiloba*).
Wiregrass and other knot weeds (*Polygonum*), Fig. 48.
Walkgrass and related grasses (*Poa*).
Catchfly and other pinks (*Silene*), Fig. 49.
Gambleweed and other sanicles (*Sanicula*), Fig. 50.
Fescue, all species with small seeds (*Festuca*), Fig. 51.
Gumweed, all species (*Grindelia*), Fig. 52.
Wild buckwheat (*Eriogonum fasciculatum*).

FIG. 23. American vetch (*Vicia americana*). Trailing or climbing, dark green plant with tendrils; coastal southern California, Coast Ranges, Sierra Nevada.

FIG. 24. Wild clover (*Trifolium* sp.). Flowers pink, red or purple; throughout nearly all of California in rather moist places.

FIG. 25. Lupine (*Lupinus* sp.). One or more species common almost everywhere.

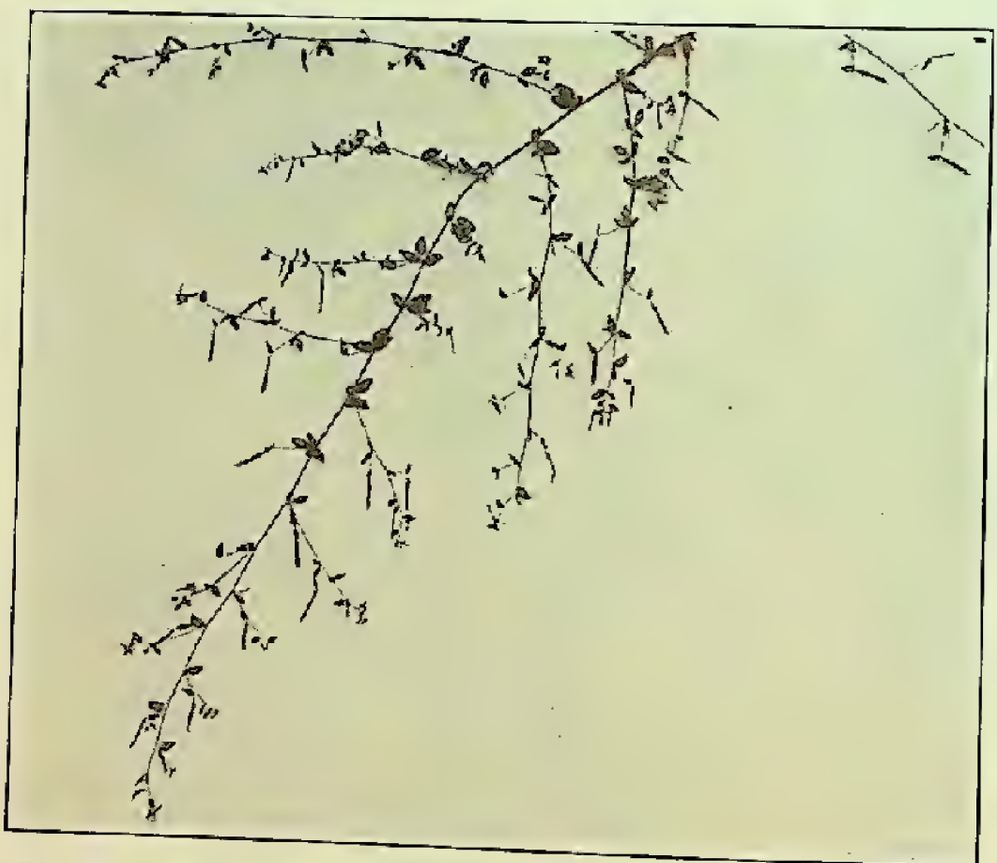

FIG. 26. Bird's-foot Trefoil (*Lotus* sp.). Usually low, inconspicuous, small-flowered; common and widely distributed.

FIG. 27. Napa Thistle (*Centaurea melitensis*). Flowers yellow; abundant everywhere in agricultural lands and pastured hills.

FIG. 28. Prickly Sow-thistle (*Sonchus asper*). Waste lands in valleys throughout California (left).

FIG. 29. Wild Dandelion (*Agoseris grandiflora*). Flowers yellow; dry slopes or flats throughout California west of the Sierra Nevada (right).

FIG. 30. Prickly Lettuce (*Lactuca scariola*). Santa Clara, San Mateo, Alameda, Humboldt, and Siskiyou counties.

FIG. 31. Tarweed (*Hemizonia* sp.). Flowers white (in *Madia* yellow); plants sticky; common and widely distributed, blooming in late summer.

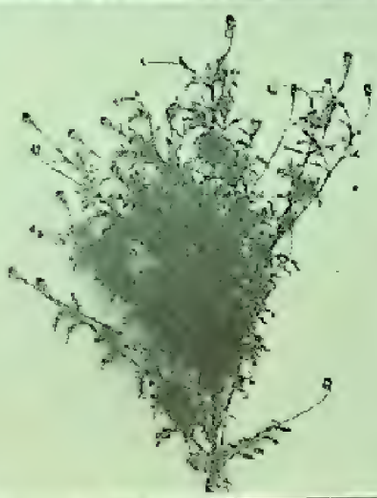

FIG. 32. Mayweed (*Anthemis cotula*). Strong scented; abundant in pastures and waste lands.

FIG. 33. Fuller's Teasel (*Dipsacus fullonum*). Plant 4-5 feet high; head rigid, prickly; waste lands, especially near the coast.

FIG. 34. Rough Pigweed (*Amaranthus retroflexus*). Coarse herb with greenish, inconspicuous flowers borne in dense spikes; 1 to 4 feet high; very common in orchards, gardens and waste lands.

FIG. 35. Filaree (*Erodium* sp.). Leaves forming a rosette or mat on the ground, toothed; photograph shows long pointed fruits which have given the plants the name "Stork's bill"; barren hillsides and dry plains nearly everywhere; one of the most important quail foods.

FIG. 36. Turkey Mullein (*Eremocarpus setigerus*). Plant forms a low, gray mat; heavy scented; dry, open areas in hills or valleys throughout California west of the Sierra Nevada (upper left).

FIG. 37. Shepherd's Purse (*Capsella bursa-pastoris*). Low, slender, with small white flowers, pods flattened and heart-shaped; common in pastures, orchards and by waysides (upper right).

FIG. 38. Mouse-ear Chickweed (*Cerastium viscosum*). Inconspicuous, somewhat hairy, low (3-10 inches high), slender; flowers small, white; common in fields and by roadsides (below).

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FIG. 39. Wild Geranium (*Geranium dissectum*). Flowers small, rose-purple; stems slender, 7-14 inches high; coast ranges.

FIG. 40. Miners' lettuce (*Montia perfoliata*). Low (4-10 inches), shade-loving; stem leaves forming a rounded disk with stem passing through the center; common everywhere.

FIG. 41. Red Sorrel (*Rumex acetosella*). Reddish-brown when mature; one-half to two feet high; seeds small, reddish-brown, numerous, triangular; throughout California.

FIG. 42. Curly Dock (*Rumex crispus*). Stem stout (1½-4 feet high); leaves wavy-margined; seeds reddish-brown, numerous, triangular. Common in neglected lands (upper left).

FIG. 43. Soft Cheat (*Bromus hordeaceus*). Abundant grass in fields and waste places (upper right).

FIG. 44. Italian Rye Grass (*Lolium multiflorum*). Common grass in fields and waste places (lower left).

FIG. 45. Buckthorn Weed or Fire Weed (*Amsinckia douglasiana*). Tall (1½-4 feet high), densely bristly; flowers orange-yellow. Common in California west of the Sierra Nevada (lower right).

FIG. 46. Pimpernel or Poor Man's Weather-glass (*Anagallis arvensis*). Low, with slender stems lying along the ground; flowers vermilion; common, mostly near the coast.

FIG. 47. English Plantain (*Plantago lanceolata*). Moist agricultural lands throughout California.

FIG. 48. Wiregrass (*Polygonum aviculare*). Prostrate, with wiry stems; flowers minute, whitish; common in hard, especially beaten soils.

Fig. 49. Windmill Pink (*Silene gallica*). Stem 10–15 inches high; flowers white or flesh color; common in fields and along roadsides.

Fig. 50. Gamble Weed (*Sanicula menziesii*). Stem 1–3½ feet high; flowers small, yellow; fruits covered with hooked bristles; shady woods in foothills.

FIG. 51. Fescue (*Festuca* sp.). Tall, slender, grasses with open, spreading heads; nearly everywhere except in desert regions.

FIG. 52. Gumweed (*Grindelia* sp.). Coarse, somewhat woody at base; flower heads gummy, petals yellow; throughout most of California west of the Sierra Nevada.

Allowing Native Food and Cover to Grow Is More Practical than Artificial Planting. Considerable experimenting has been done in the eastern states (Stoddard, 1933, p. 382; Wight, 1933, p. 15) on the planting of food crops in "bird feed patches" for the bobwhite and other game birds. In the Santa Cruz Mountains similar experimental plantings were made, but were found to be unnecessary because of the abundance of the native plants which responded to the disking treatment. These findings probably apply throughout most of California; moreover, in many parts of the state cultivated bird foods would require irrigation, thus making such a project prohibitively costly. In general, the problem of restoring food and cover for quail amounts to giving the native plants a chance to come back rather than in putting in new crops; however, for the benefit of those who intend to establish new plantings for other purposes, methods are outlined below which will benefit quail at the same time.

Range and Forage Crops of Value to Quail. Bur clover may often be used either to reseed old pasture lands or to accelerate the formation of new ones in lanes cleared through the brush. Not only does it establish and maintain itself readily but in addition it constitutes one of the most valuable forage plants in the state (Hart, Guilbert and Goss, 1932, p. 52). Directions for its cultivation are given by Piper and McKee (1915). This plant constitutes 14 per cent of the entire food of quail in the area covered by the present study.

The purple and common vetches are valuable as green feed, as hay, and as cover and green manure crops, in addition to being suitable for quail. They are adapted to the coastal regions of California, but unlike bur clover they do not reseed themselves. Directions for their cultivation are given by Piper, McKee and Hillman (1923), and by McKee (1925).

Where irrigation is possible, other food crops may be planted, but this will usually be on strictly agricultural lands rather than on brush lands of the marginal type. Alfalfa is readily eaten by quail, and in localities where free water is scarce the succulent leaves may sometimes be of special value in tiding over families of young quail during periods of drought (page 316).

Sour clover (*Melilotus indica*), planted in strips or patches like alfalfa, is of similar value; however, sweet clover (*Melilotus alba*) appears not to be relished, at least by the bobwhite, and is believed to be deficient in nutritive value (Errington, 1931, p. 8; Wight, 1933, p. 16).

Some of the cultivated grasses, notably Sudan grass, are valuable as cover, and probably also as food when allowed to go to seed; however, warning must be given that quail are often slow in learning to adopt new foods (page 190, Part I).

Although corn is high in nutritive value and is much used in the Eastern United States to supplement the native food during periods of deep snow, experiments with the California quail of the Santa Cruz Mountains demonstrated that whole kernels were rejected and that even cracked corn was eaten very sparingly. The birds spent considerable time in cornfields, but this was for the sake of the weeds which sprang up there as a result of cultivation. Possibly California quail may gradually learn to eat corn in regions where the crop is common,

and possibly they have done so already in some sections; however, unless it is definitely known that the quail of a given region are used to corn, it should not be put out for their benefit, particularly in the case of emergency winter feedings. Sometimes several seasons elapse before quail learn to adopt a new food item. Sunflower seeds were consistently refused, apparently because of too large size, as were the large kernels of barley in most cases, although certain coveys in the vicinity of planted fields learned to eat them in quantity.

Planning of Hedge, Shrubbery and Garden Arrangement for Quail. Many persons would enjoy having quail and other birds in large numbers around their homes. Here again, assuming that marauding house cats are absent, and the activities of dogs supervised, the method is simply to furnish food and cover. Adequate ground cover must be near at hand so that the birds, always nervous even under the best conditions when far from shelter, may feel at ease when vehicles and human beings are coming and going in their neighborhood.

Cover may be supplied by hedges of blackberries or raspberries, which will also furnish the birds with a limited amount of food during hot weather. A single hedge eight or more feet thick will suffice, or if it is intended that the owner harvest the maximum berry crop himself, several narrow, parallel hedges, set close together, will do. Hedges of rose bushes are equally good, and if the roses are climbing varieties they may be used to cover fences, thus creating an attractive effect as well as providing an ideal sanctuary for quail and other birds, many of which will nest along such fences (Fig. 20). Grape or honeysuckle vines may also be used for this purpose.

Along the borders of such hedges the ground may be disked or plowed to insure a good crop of weed seed, or the hedges can be used to make attractive boundary fences for the family garden or orchard, in which case the weed crop will arise incidentally to normal cultivation. In cases where a small area near a dwelling is cultivated primarily for the purpose of attracting songbirds and quail, the reluctance of the latter to venture far from cover should not be forgotten, and when such areas exceed about 20 feet in width they should be planted with strips of hedge or similar protective cover. Brush piles although not so attractive may be used instead of hedgerows, and their appearance may be improved by planting with climbing vines.

The planting of hedges along roadsides where they do not hinder visibility on curves is recommended, and also, whenever possible, along wire fences, particularly those made of woven wire, since such fences are responsible for the deaths of many quail every year (page 243, Part I) through collision.

Lists of ornamental plants, both native and introduced, which are useful for attracting birds have been compiled by McAtee (1910, 1916). These lists are recommended for use whenever the planting of additional shrubbery around homes and buildings is contemplated; however, it should not be forgotten that such shrubs will be of most use as cover rather than as a source of food supply, as noted above (page 280). Two groups of cultivated ornamentals which are notable exceptions to this rule are the acacias (*Acacia*, any species) and the Scotch and Spanish brooms (*Cytisus scoparius* and *Spartium junceum*). Although they are trees and shrubs, these plants belong to the pea family, which

constitutes 32 per cent of the food of quail, and their abundant seeds and excellent cover make them highly attractive to the birds.

Trees for Roosting. If in addition to ground cover and food there are one or more moderate sized, *densely* foliaged trees around the dooryard, the quail may form a regular habit of roosting in them, if undisturbed at night. Some trees with foliage requisitely dense are as follows: Live oak (*Quercus agrifolia*, Fig 53); California laurel, or bay tree, (*Umbellularia californica*, Fig. 54); orange, acacia, eucalyptus, cypress (*Cupressus*), incense cedar (*Libocedrus decurrens*) and firs (*Abies*) when unusually dense; also rose tangles (Fig. 20), grape tangles, etc., if extending to a height above about 12 feet and if sufficiently dense.

Adequate roosting cover is important in protecting quail from owls and ground prowlers. In central and northern California where tree growth is usually abundant the birds are well protected, but in the more arid regions of southern California, roosting cover is sometimes exceedingly scanty, so that the quail fall prey to owls much more frequently than elsewhere. In these latter regions, one or two sumacs, acacias or orange trees may act as the deciding factor between the slow dwindling away of a given covey due to nightly losses and its healthy maintenance.

WATER REQUIREMENTS OF QUAIL

Drinking Water Not Required During Winter and Spring. Quail require no drinking water during the rainy season because they receive enough moisture from the tender green vegetation to entirely satisfy their needs (page 192, Part I). However, from the time that the vegetation commences to dry up in May until the first new growth appears again in November (dates will vary somewhat according to the locality and year) the birds must largely depend upon some other source of water such as springs, pools, or streams.

Summer Requirements. Because quail nests are seldom located more than a quarter of a mile from water, it has been supposed that the newly hatched quail require water to drink within a few hours and that this distance represents the maximum that such small young are able to travel for it. In general this is true, but experiments carried out during the present study show that the young, like the adults, require no drinking water, *provided*, they have access to succulent green vegetation. The significance of this experimentally determined fact should be tested further under natural conditions; however, it strongly indicates that quail can raise broods in agricultural regions where there is no permanent supply of drinking water (as in localities where irrigating is done at intervals of two weeks or a month), so long as there is available to them a plentiful supply of succulent vegetation, either crops, such as alfalfa, or weeds.

In a state of nature, hatching of the young occurs during the dry season, when fresh green vegetation has almost completely disappeared, so that all ages are usually dependent upon free water as their only source, which explains their customary close association at such times

FIG. 53. Live Oak (*Quercus agrifolia*). This common and widespread oak furnishes excellent roosting cover on account of its dense foliage. The tree shown here was habitually used for this purpose by a certain covey of quail in the Santa Cruz Mountains.

FIG. 54. California Laurel or Bay Tree (*Umbellularia californica*). From the point of view of quail, this tree is second only to the live oak as roosting cover.

with water holes and streams. In addition, the last traces of edible green vegetation which remain at that time are also found at the water holes.

Effect on Quail of Exclusive Use by Man of Water Sources. There is no doubt that exclusive appropriation of the water supply by man has rendered considerable areas in California uninhabitable for quail and other birds (Grinnell, 1927). Although this man-caused water deficiency tends locally to reduce the number of potential coveys even in such comparatively well watered regions as the Santa Cruz Mountains, it becomes a factor of major importance in the arid portions of southern California. In western Riverside County, for example, where the locations of the few scattered ranches are determined by the presence of water, practically every little spring and seepage has been boxed up and the water piped to the ranch house. Although some of this water is returned to the land by irrigation, or exposed at drinking troughs, this is usually the case only near the farm buildings, to which the birds are afraid to bring their tiny young or where they suffer losses from cats and dogs if they do come in.

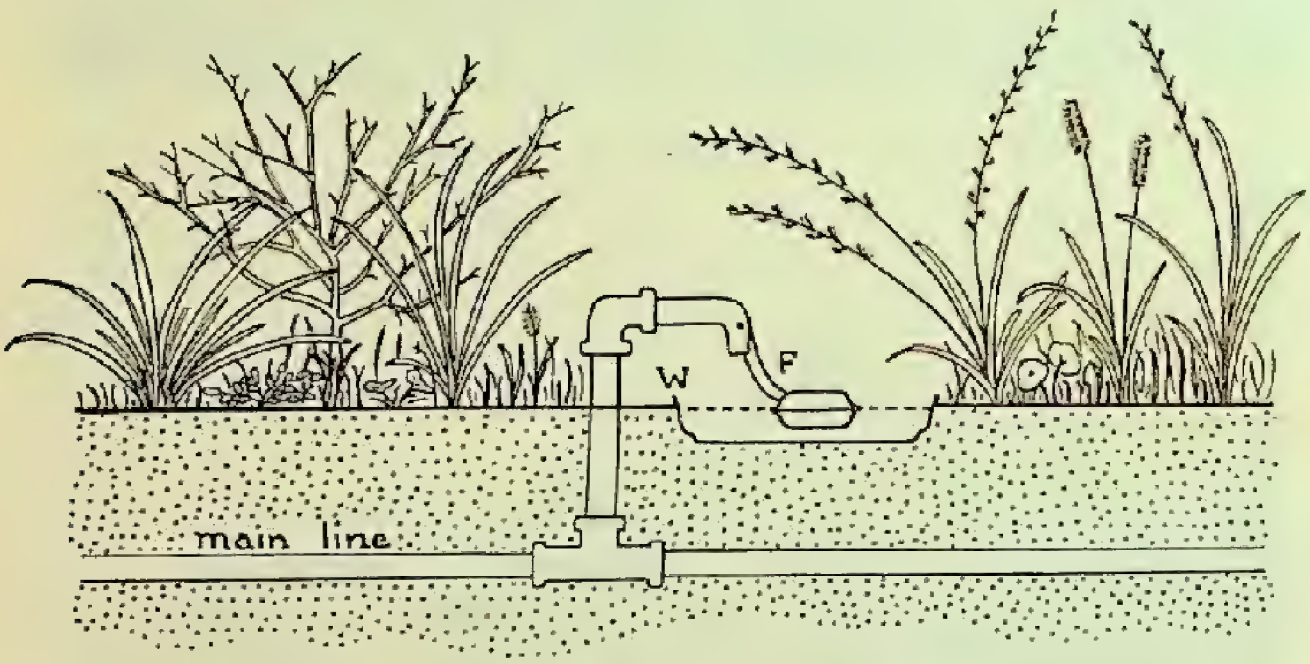

FIG. 55. An economical method of supplying water for birds by means of a tee inserted in the main line and fitted with a short piece of pipe and a float valve, as described in the text. W = water dish; F = float.

Even the water troughs for domestic stock which are some distance from the ranch buildings are frequently of no use to the birds because the inlet pipes are fitted with float valves so that no water can run over. Unless such troughs happen to leak, the water is totally unavailable for small young. The chief water supply for quail in a section of country which extends for many miles through San Diego County is furnished by small leaks in a wooden aqueduct used by the City of San Diego. Should this aqueduct be repaired or replaced, all the "restocking" in the world would be of no avail in maintaining birds in the waterless area. In the Owens River Valley, part of which has become a semidesert since the diversion of the river through the Los Angeles Aqueduct, the resident quail have completely vanished from thousands of acres where formerly they were abundant.

Economical Methods of Supplying Water. Those who are interested in supplying quail and other birds with water may do so in various ways which involve only a trifling expense. When a pipe line is present a tee may be inserted in the line at the proposed watering site and a short piece of pipe terminating in a float valve installed (Fig. 55). A low-priced float valve, and a small crockery water dish, can be obtained at almost any poultry supply store. The dish should be so adjusted that the depth of water is not much more than three-fourths of an inch, to prevent very young birds from drowning; deep dishes can be made suitable for the purpose by filling with pebbles or sand. A drinking device of this sort will require no attention other than an occasional visit to clear away debris that may have lodged in the dish. It is of course important that water dishes be located at the edge of or partly overhung by cover so that the birds will be at ease, and fairly safe from the attacks of enemies. If no cover is close at hand it may be supplied by piling brush, and the brush may be planted with climbing vines to make it more attractive.

For regions where there is no piped water supply, a large used oil drum and water pan equipped with a simple automatic feed device, as described by True (1933*a*, p. 21), has proved highly satisfactory and is in regular use on a number of state-operated quail refuges.

GENERAL RECOMMENDATIONS FOR CHOOSING A QUAIL REFUGE

Estimating Capacity by Extent of "Edge" Land. If the general principles underlying quail requirements, as outlined in the foregoing pages, are borne in mind, one can estimate the value of a given piece of land as a quail refuge with considerable accuracy, and can judge whether or not it will be possible or practicable to build up any essential factors which may be lacking. The adequacy of the food supply may be judged by ascertaining the extent of "edge" land (page 281), provided the amount of grazing done by live stock is taken into consideration. Cover should be abundant, including proper places for roosting; the presence of a natural water source is not essential if arrangements can be made to supply it artificially as explained above.

Number of Birds Strictly Limited by the Capacity of the Land. Since the number of quail which a given area will support is strictly limited by the amount of available food and cover, as previously emphasized, considerable disappointment and expense will be saved if it is realized that a crop of quail is governed by the same general laws of maintenance which govern a crop of range cattle or other live stock exclusively dependent upon the land for food and shelter. The stockman knows, for example, from the quality and amount of forage on a given range, how many animals it will support, and how many he may take from the herd each year without unduly decreasing the breeding stock, and although it may never have occurred to many people that such information is necessary for the proper harvesting of a quail crop, in reality it is just as essential in one case as in the other. In the Old World the management of grouse upon a crop basis, including a careful estimate each year of the harvestable surplus,

has been successfully practiced for half a century (Committee of Inquiry on Grouse Disease, 1911, p. 456).

Best Time of Year for Selecting Refuges. Judging the value of a piece of land for quail production is most safely done during the winter months prior to any considerable growth of new vegetation, because this is the critical season as regards food supply and sometimes cover as well. On the other hand, the time to check the water supply is during the early fall months, or immediately preceding the beginning of the winter rains.

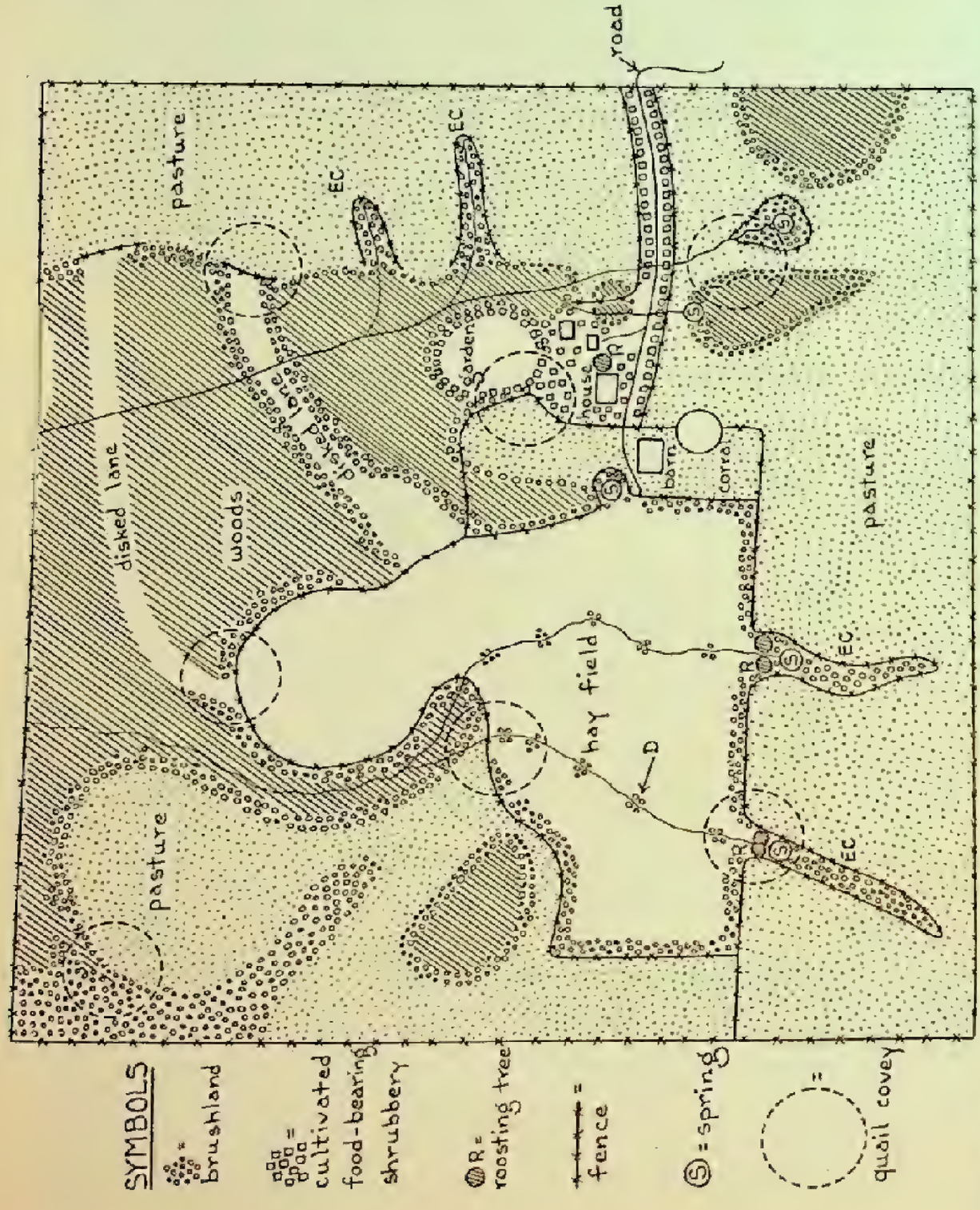

FIG. 56. Diagram of an area in the Santa Cruz Mountains where an experiment on the increased production of quail is being carried on. Note large amount of "edge" land resulting from observance of methods of treatment of the various types of land as outlined in the text.
D—brush soil-saving dam for checking erosion.
EC—fenced-in brush-filled gullies for checking erosion.

The number of quail present will furnish a good measure of the adequacy of the land unless the area has been hunted over since the last breeding season. If no quail are present the locality should be very carefully investigated before being chosen as a refuge, no matter how favorable it may appear superficially. If it turns out that hunting is not the cause for the lack of birds, there must be one or more unfavorable factors present in the environment. Determining what these are and altering them should precede any move toward restocking.

Fig. 56 represents an area in the Santa Cruz Mountains where an experiment on the increased production of quail is being carried on. Although this piece of land is potentially first-class territory for quail, its actual production is low at the present time, due chiefly to overgrazing and lack of erosion control (Figs. 14, 15). It is fully expected that following improvement measures now being undertaken, an increase of quail amounting to 100 per cent at the very least will result.

THE NATURAL ENEMIES OF QUAIL

GENERAL POLICY

Plan of Treatment of Subject Followed Here. As our knowledge increases, the dispute as to the effects of natural enemies on game, and how much they should be controlled, is gradually becoming obsolete. Unfortunately for the welfare of the wild life, it takes time for new information, however sound, to overcome deep-seated prejudices, so that even at present some persons still cling to the two opposite extremes of the old argument. Some biologists and students of natural history would like to have no control at all, whereas many hunters and farmers want as much as they can get, even to complete eradication. Actually, the conflict of interests is not nearly as great as the opposing factions imagine and can usually be worked out in a manner fairly satisfactory to both.

In the hope of clarifying the predator question, as regards quail, the plan followed here will be to point out the unsound aspects of the two extreme positions while indicating briefly the common ground upon which they may unite. Following this, the status of each of the various natural enemies of quail will be given, with directions for control where this is desirable.

Mistaken Belief as to Universal Efficacy of Predator Control. The belief of some hunters is that predatory animals are chiefly responsible for the decrease in quail, and that if the predators are reduced or eradicated, the quail will somehow come back. The briefest possible consideration of the food and cover requirements of quail, together with the widespread shrinkage of territory offering such requirements, as previously outlined, ought to convince anyone that predator control alone can never hope to bring back quail to lands which have been so radically altered by man.

Extensive field studies made by various observers all show that so long as food and cover remain adequate, vigorous quail are quite able to take care of themselves, so that predatory animals living in the heart of a quail range are unable to get more than a small fraction of them.

However, as soon as the food supply becomes exhausted the quail lose their vitality and fall prey in larger and larger numbers to these same natural enemies. Such weakened birds are already doomed, and it makes little difference whether their actual demise results from predator attack or from slow starvation. In other words, *heavy loss by predators is a symptom of inadequate food and cover,* and merely getting rid of the predators (even when this is possible) will not prevent the quail from continuing to disappear. On the other hand, if the same amount of energy is put into improving food and cover, the birds will be able to maintain themselves in spite of the predators.

In California one of the many instances of the futility of expecting quail to come back on a given area merely by killing predators is furnished by the Spring Valley Water Company experiment on the San Francisco Peninsula. From 1912 to 1923 (during which time, also, no hunting was allowed) predatory animals were trapped in large numbers every year for the express purpose of bringing back the quail, yet the birds continued to decrease (Lawrence, 1922; Bryant, 1923). In another experiment, at Newman, quail *were* successfully brought back on a piece of property where predators were not at all controlled (Newsome, 1927, p. 66).

Utility of Moderate Control from Point of View of Hunter. Where no quail hunting is done the predators tend merely to take the seasonal surplus which could not get through the winter on the existing food supply anyway. Where quail hunting is done, however, they take part of the seasonal surplus which would otherwise be available for the hunter, and for this reason it is to the interest of the latter to practice a certain amount of predator control in restricted localities in order to insure the maximum seasonal take. The desirability of moderate control for game production purposes is generally agreed upon by present authorities, but the word *moderate* must be emphasized, because indiscriminate control of predators is biologically unsound and also exceedingly expensive.

Comparative Low Cost of Moderate Predator Control. By "moderate" or regulated predator control, as contrasted with indiscriminate control, is meant the keeping in check of only those predators which are known to be harmful, as well as the maintenance of the proper balance between control measures and measures for improving the environment. The real enemies of quail constitute only a small number of the large group of so-called "predators," so that if control is restricted to these few, it will prove neither very expensive nor energy-consuming. The most important of these enemies are the Cooper and sharp-shinned hawks, horned owls and jays in certain districts only, and certain snakes (see page 325 for control methods). Others, particularly foxes, bobcats and skunks, may become important where locally numerous, but otherwise their control will not be justified, at least until the more important program of food and cover improvement has been completed.

Improvement of Quail Habitat Tends to Reduce Predators. Usually the steps taken to improve the environment for quail in a given locality will automatically render it less favorable for the enemies of

the birds. For example, the partial clearing of densely wooded areas will reduce the nesting territory available for Cooper hawks. The presence of the open areas will also permit the game manager to make the rounds of his territory more easily and will make the shooting of these hawks less difficult.

High Cost and Wastefulness of Unregulated Predator Control. Aside from its biological unsoundness, indiscriminate predator control is the most costly and wasteful of all methods of improving game conditions because the would-be game manager is never done with it. If he slackens his activities for only a few weeks or months the "protected" area fills up again with more predators from adjacent areas. The writer received an impressive object lesson in this regard while collecting jays for stomach examination in a quail refuge in the Santa Cruz Mountains. During a three-weeks period in 1932, 72 birds were collected from an area comprising about five acres. In certain cases a dozen or more jays were collected from well frequented localities in the course of two or three days, yet at the end of a week these localities were as well populated as ever. In 1933 jays were collected from the same area during a similar period, but with no visible decrease in the numbers of the birds.

For more than ten years predatory animal control was assiduously practiced on the lands of the Spring Valley Water Company, at a cost which can only be guessed at, yet at the end of that time the number of animals present was apparently just as great as in previous years (Bryant, *op. cit.*, p. 111). As an experiment in predatory animal control, the Division of Fish and Game had nine predatory animal trappers working in as many state refuges during an 18-month period in 1932 and 1933. The catch of 932 bobcats and coyotes required the setting of 71,693 miles of trapline with a total of 90,922 sets, and an expenditure of $13,099.35 on salaries alone, amounting to a cost of $14.05 per animal. Of all these animals only seven had eaten quail, although quail were particularly abundant in certain of the refuges. "Beginning July 1, 1933, it was found necessary through lack of funds to reduce the number of trappers to four" (McLean, 1934, p. 30).

The instances cited above indicate something of the cost in time and money, as well as the results to be expected from the usual indiscriminate type of predatory animal control. The enormous amount of energy wasted throughout the country each year by sportsmen's "drives" on "vermin" is another case in point. In one recorded case 1531 jays were killed in a single "blue jay hunt" at Hollister, California, with no permanent results (Grinnell, 1922, p. 13) to justify the expenditure. Such drives even if conducted in an ideally judicious manner, so as to kill only the real enemies of game, could not possibly produce lasting results because of their sporadic nature. In addition they almost invariably result in more harm than good because the hunters do not distinguish between friend and foe but shoot at everything which has claws or a hooked beak.

For example, suppose that in trying to protect a certain quail covey, the hunter fails to bag the elusive resident Cooper hawk which has been catching quail off and on for months, but instead manages to bring down a couple of big, slow flying red-tailed hawks. This

accomplishment will not prevent the Cooper hawk, which is the real enemy of the quail (page 325), from taking its customary toll whenever the birds are forced out into the open by the gradual depletion of their food supply. On the other hand, the killing of the two red-tails, which are not enemies of quail (page 331), will probably mean the survival of 20 meadow mice, or their equivalent in other harmful rodents, which otherwise were destined to be killed by the red-tails within the ensuing three weeks. Meadow mice compete directly and effectually with quail for food at all times, storing in their underground burrows what they can not consume at once. In addition to the harm done to the quail through the killing of the red-tails, by allowing the meadow mice and other rodents to remain unchecked, there is strong indication that the elimination of such large hawks tends to increase the number of Cooper hawks by relieving the latter of some competition; thus Eaton (1931, p. 426) finds that in New Jersey, as a result of hawk drives covering six years, Cooper and sharp-shinned hawks appear to have increased nearly 14 per cent while the large, slow-flying hawks decreased as much as 54 per cent. A further source of harm in such indiscriminate "vermin" campaigns is that the energy of the participants is wasted in futile and destructive measures so that the possibility of productive activities, such as improving feed, cover, and water conditions, is overlooked.

The Real Enemies of Quail in No Danger of Extermination; Reconciliation of Opposing Interests. Although the complaints of biologists and natural history students regarding indiscriminate predator control are justified, as previously indicated, yet nearly all of this group will concede that predators such as the Cooper and sharp-shinned hawks, which are the real enemies of quail, are at present in no danger of extermination. Moreover, it seems only fair that if the sportsman spends his time and money (which he often does to a greater extent than any other group) in an honest attempt not only to raise a game crop but also to improve wild life conditions, he should not be grudged the privilege of exercising moderate control over the limited number of species which are enemies of his crop. On the other hand, if the sportsman will learn to control only these real enemies of quail, and to refrain from indiscriminately slaughtering the other so-called predators which are known to exert a beneficial effect upon quail unless very numerous, he will find that opposition to his activities has largely vanished.

Leopold has expressed the situation admirably: "There is [for the sportsman] only one completely futile attitude on predators: that the issue is merely one of courage to protect one's own interests, and that all doubters and protestants are merely chicken-hearted" (1933, p. 252).

Some Beneficial Effects of Predators Which Are Not Serious Enemies of Quail. Predators exert at least two important beneficial influences upon quail which can hardly be taken over by man. One of these is the elimination of diseased or otherwise unfit birds before they can transmit their defects either by contagion or heredity. Of course this function of predators comes into action only when there are sick birds present on the range, and since California quail in a

natural state are apparently little subject to diseases under ordinary circumstances, the function is seldom observed. However, it may be strongly argued that this very healthiness of our birds has resulted from their age-long association with certain predators. In England, where predators have been over-controlled, the red grouse is notoriously subject to disease. In any event, we must not lose sight of the fact that if a serious disease ever should break out among our quail, there is no known agency other than predators which could act as a "sanitary brigade" for the removal of infected birds. That diseases exist among our California quail which might conceivably become epidemics were it not for the predators has been pointed out by O'Roke (1932, p. 425).

The other beneficial influence exerted by predators acts practically everywhere and at all seasons. This is the constant reduction or control by them of the rodents which eat the same foods as do the quail and which may in places become largely responsible for the midwinter shortage because of their numbers which in comparison to those of quail are huge. For example, if a horned owl averages one wood rat or its equivalent for every two nights of hunting, and this is doubtless a fair estimate for the Santa Cruz Mountains, the owl will destroy 184 of these animals each year. Since an adult wood rat must consume at least as much forage every 24 hours as a full grown quail, the importance of holding such a formidable competitor in check is evident.

The most destructive enemies of quail, such as the Cooper and sharp-shinned hawks, in addition to their direct damage, apparently exert the beneficial effects just mentioned to a much smaller degree than do the less important predators, which are usually able to capture only weakened or unfit birds.

THE IMPORTANT ENEMIES OF QUAIL AND THEIR CONTROL

COOPER HAWKS

Damage. The Cooper hawk, commonly known among hunters as the "bullet hawk" because of its rapid flight, is the arch-enemy of quail in all sections of the country. The species is most abundant in winter because the resident population is reinforced at that time by migrating individuals from the north. When one of these hawks has located itself in the territory of a quail covey it will try to get a quail nearly every day, and often several times each day. Unlike the red-tail and other large, slow-flying hawks, the Cooper hawk can fly rapidly through dense woods, and this habit renders it very difficult to shoot. If it misses a quail it will sometimes even pursue the bird through the brush on foot, although if the cover is thick the quail has the advantage.

Where cover is adequate the wariness of a covey of mature quail, more often than not, is too much for the hawk, so that on the whole it does less damage than one might suppose. Out of all the tries which I have personally seen Cooper hawks make for quail, none happened to be successful, but this was in a region where cover is exceptionally abundant. Even under the most favorable conditions, however, the species constitutes a slow, constant drain on any quail covey, no matter

how disciplined by experience, while in the fall months, when the untried young make up the majority of the quail population, the toll which it takes is heavy.

Control Methods. Because of its well known habit of skulking in thick cover, this hawk is able to elude the hunter and persist year after year even in localities where large, slow-flying hawks such as the red-tail are gradually killed off. During the summer months nests of the Cooper hawk may sometimes be located and broken up, but the birds

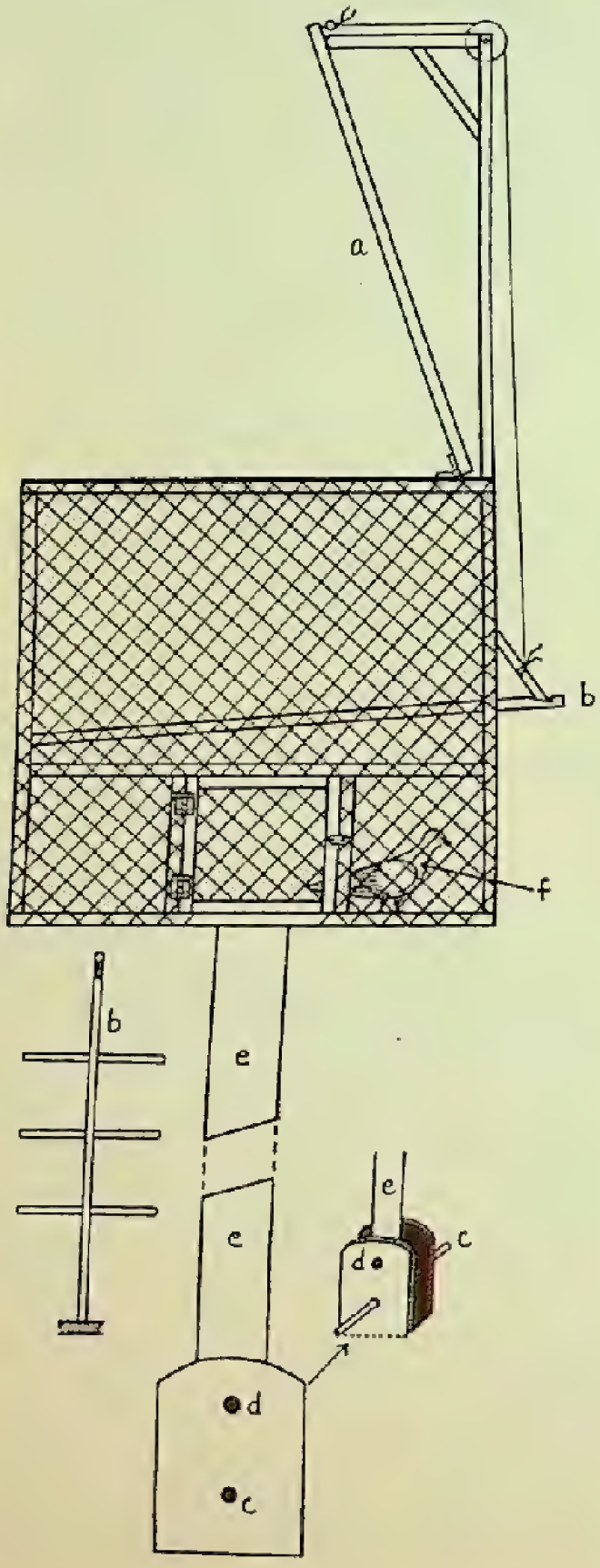

FIG. 57. A simple live trap for hawks which permits the release unharmed of beneficial species (after Engelmann, in "*Die Raubvogel Europas,*" published by J. Neumann).
a—hinged lid.
b—hinged trigger upon which hawk perches (two views).
c—removable peg which permits hinged pole to be swung to the ground.
d—hinge upon which end of pole turns when being lowered to the ground.
e—pole of trap.
f—pigeon or sparrow in lower compartment, used as bait; a rat or mouse would also do.

are so secretive during this period that the finding of nests is by no means easy, even on well cleared land, while it is practically hopeless in heavily wooded regions. Moreover the numbers of the hawks are at a minimum at that season because the winter migrants are on their breeding grounds in the north. For this reason control is better practiced in the fall and winter.

Under ordinary circumstances, shooting is the best method of keeping this species under control. In the case of closely managed refuges and game preserves which are patrolled by a full-time field worker, trapping may occasionally prove more efficient. The practice of trapping hawks has been subject to great abuse, however, and should never be carried on by persons who are not fully qualified to distinguish Cooper and sharp-shinned hawks from the other, beneficial species. The use of pole-traps can not be too strongly condemned because many more useful than harmful birds are destroyed. A good object lesson against the use of pole traps is furnished by a recent experiment in Michigan made by the State Department of Conservation, together with the School of Forestry and Conservation, on the results of pole-trapping on state refuges (Wight, 1931).

An excellent trap for catching Cooper and sharp-shinned hawks is shown in Fig. 57. It is highly efficient, yet free from objection because it catches its victims alive, which permits the liberation of beneficial species unharmed.

Compensating Effect of Cooper Hawks Where Not Numerous. The game manager need not be worried if one or two Cooper hawks are able to persist in a given refuge in spite of all his efforts to get them, because an important benefit resulting to quail from the presence of a few of these hawks is the destruction of large numbers of seed-eating migratory sparrows, such as golden-crowned, white-crowned, and fox sparrows. Such small birds out-number the quail more than ten to one, are more easily captured, and far outweigh quail in the hawks' bill of fare. These sparrows move southward each fall into the quail territory in vast hordes and remain all winter, feeding on just the food upon which the quail are dependent. For man to try to "control" this limitless army of sparrows would be out of the question; on the other hand, the Cooper and the sharp-shinned hawks, which probably average at least one sparrow per hawk every two days, are most efficient control agents.

SHARP-SHINNED HAWKS

Only Females Dangerous to Quail. This species is almost identical in appearance with the Cooper hawk, except that it is about one-third smaller. Its habits and methods of control are similar to those of the latter; however, because of its smaller size only the females (which are larger than the males) are, as a rule, able to catch quail, the males being restricted to song birds and prey of similar small size.

HORNED OWLS

Where Cover is Adequate. In the northern portions of California and other areas where roosting cover for quail is abundant, this owl appears to do no serious damage, and in view of the study made in the Santa Cruz Mountains, its control under these conditions will hardly

be worth while. It must not be forgotten that the horned owl preys largely upon rabbits, gophers, wood rats and similar rodent competitors of quail, which probably renders it considerably more beneficial than harmful in most localities. It is also at least an occasional enemy of the Cooper hawk and the house cat.

Where Cover is Scanty. In parts of southern California, as in western Riverside County where roosting cover is exceedingly scanty, the number of quail taken by horned owls is sometimes considerable. This is due of course to a faulty environment, and the problem should be attacked from that angle wherever possible; however, it is probably advisable to spend some time on control measures as well. Methods recommended for the Cooper hawk will prove successful.

SNAKES

Damage. The evidence against certain kinds of snakes as destroyers of quail eggs and young would probably be greater if the unobtrusive habits of these reptiles did not make observation so difficult. Enough records are available, however, to indicate that during the nesting season a few large species may be important enemies of quail. The snakes recorded as having eaten quail or their eggs, in California, are as follows: gopher snake (*Pituophis:* Hoover, 1899, p. 75; McLean, 1930, p. 6), king snake (*Lampropeltis:* Van Denburgh, 1922, p. 756; Compton, 1933, p. 71), milk snake (*Lampropeltis:* McLean, *op. cit.*), rattlesnake (*Crotalus:* Pierce, 1933, p. 62). With the exception of the species listed, the majority of snakes probably exert a beneficial influence on quail indirectly by destroying large numbers of rodents.

Control. Where snakes are not particularly numerous, their control in California can often be left to the large soaring hawks, such as the red-tailed hawk and the golden eagle, which may be considered among their most effective enemies.

HOUSE CATS

Control. Wandering house cats are universally regarded as destructive to bird life, including quail; they can be most effectively controlled by box traps. Numerous reports received by the writer indicate that bobcats and coyotes are important enemies of house cats, as are horned owls, and at least occasionally, even eagles. Although the relative importance of these enemies is not yet known, it is evident that some factor is working to prevent the increase of house cats, for otherwise our wild lands would be much more heavily populated with them than is the case.

UNIMPORTANT OCCASIONAL ENEMIES OF QUAIL AND HARMLESS SPECIES

JAYS

Damage. The belief that jays habitually destroy the eggs and small young of quail is widespread. Actually the damage done to quail

appears to be much less than is commonly supposed. It is true that jays have been seen to kill and eat young quail, and their carnivorous habits are also indicated by their eating young chickens and brush rabbits, while Beal has shown that they destroy large numbers of eggs and young of songbirds (1910, pp. 48, 54). However, these losses appear to be only occasional in the case of quail, whose ground nests seem to be much better concealed from jays than are those of the songbirds. In the Santa Cruz Mountains the writer collected 100 jays during the time that young quail were hatching in maximum numbers, yet not a single stomach contained either quail eggs or young. The harmlessness of jays in this locality is probably typical of those parts of California where cover is adequate. In many cases California quail have proved themselves capable of driving intruding jays away from their broods (page 240, Part I). Moreover, jays do a certain amount of good by warning other birds of the approach of a Cooper hawk, although they are not absolutely trustworthy in this regard (page 220, Part I).

Control. In parts of southern California where cover is scanty, control measures may occasionally be warranted. However, as pointed out previously, the rapidity with which jays fill up the gaps in their ranks makes effective control exceedingly difficult. Shooting has proved the most effective method.

ROAD-RUNNERS

Road-runners have been observed to take an occasional egg or young quail, but such cases are exceptional, in spite of some local public opinion to the contrary. Bryant found not a single trace of quail in 84 stomachs, the largest number of which were collected in San Diego County during the breeding season of quail. He concluded that "the destruction of a road-runner can be justified only under exceptional circumstances, and certainly the wholesale destruction of the species because of its supposed habit of destroying the eggs and young of quail is unwarranted" (Bryant, 1916*a*, p. 48). It is only too easy to fall into the unbalanced, destructive attitude which favors "control" (by which is usually meant unlimited killing) of any living thing which one can not immediately prove to be wholly beneficial to the thing being "protected."

BOBCATS

Damage. Although bobcats are popularly regarded as dangerously destructive to quail, this belief is not supported by stomach examinations. Of 156 bobcats taken by state trappers on nine California game refuges, only 3 per cent of the stomachs contained quail (McLean, 1934, p. 32), while out of eight additional stomachs of bobcats taken in southern California from state-operated quail refuges and examined by the writer, none contained quail (page 241, Part I). Dixon (1925, p. 36) found that out of 218 bobcat stomachs, all kinds of birds together amounted only to about 4 per cent of the total food. Bobcats live chiefly on rabbits, wood rats, gophers, and other rodent competitors of quail, and in addition, as mentioned previously, they probably serve to keep house cats in check.

Control. Where bobcats become excessively numerous they may often be sufficiently controlled by allowing private trappers for fur to harvest the crop.

COYOTES

Damage. Coyotes, like dogs, are much less likely to catch quail than are cats. McLean (*op. cit.*) found quail in less than 1 per cent of 240 coyote stomachs taken on nine state game refuges, and the writer found no remains at all of quail in 15 stomachs taken from various quail refuges in southern California. Dixon (*op. cit.*, p. 39) records bird remains of all kinds in only 2 per cent of 185 stomachs; Sperry (1933, p. 219) reports game birds (7 out of 35 were quail) in 4 per cent of 1419 stomachs. Forty-six per cent of the food of coyotes consists of rodent competitors of quail; in addition they appear to be of some importance as a check on feral house cats.

Control. If coyotes are found breaking up quail nests at all frequently, it is a sign that the environment is at fault and the measures taken should be directed chiefly toward cover improvement.

SKUNKS

Damage. Although skunks are often accused of destroying quail nests, stomach contents, as in the case of the bobcat, show little evidence of this. McLean found no traces of quail or their eggs in 38 skunk stomachs collected from state game refuges; while from an examination of the contents of over 300 stomachs of skunks Dixon concludes that "only 5 per cent [is] of harmful significance" (*op. cit.*, p. 46).

Control. Directions for trapping have been given by Sumner (1932, p. 34).

FOXES

Although foxes in the eastern United States have been reported to destroy considerable numbers of grouse nests, they do not appear to be very important enemies of quail, except perhaps locally. In California their importance to quail is probably not great under the usual conditions of relative abundance. McLean (*op. cit.*) found quail remains in 2 out of 51 stomachs.

GROUND SQUIRRELS

Damage. Ground squirrels have been known to take quail eggs (Kellogg, 1931, p. 6), although this must not happen very frequently where cover is adequate. More important is the fact that where numerous, these animals are competitors of quail for food.

Control. The most economical control device is represented by the large, slow-flying hawks. Where additional measures are necessary, gassing of burrows is recommended, as described by Storer (1933, p. 14). Thallium-poisoned grain should not be used where conservation of quail is an objective, because it is fatal to them.

RED-TAILED HAWK

Authorities are agreed that the red-tail is too slow-moving and clumsy to catch healthy quail where cover is adequate, and that it should be protected because of its value in destroying rodents. In regions where game farm-raised quail have been liberated on lands with inferior cover, a few losses have been noted (page 239, Part I), but it is obvious that such exceptional occurrences furnish no excuse for destroying these hawks under ordinary circumstances.

About 86 per cent of the food of the red-tail consists of rodents which are injurious to agriculture and which compete with quail, while this hawk is one of the most important bird enemies of snakes. In addition it is a decidedly handsome bird and lends a touch of romantic wildness to our California landscapes which perhaps only those who have lived in the "civilized," hawkless regions of the eastern United States can fully appreciate. In recognition of its valuable services this bird is protected by law.

MARSH HAWK

This species has been accused of destroying many kinds of game birds, but the charges are seldom corroborated by stomach-content findings. As an example of the manner in which a maligned species may prove to have an effect in reality the reverse of that which is popularly supposed, the findings of Kellogg on marsh hawks living in heavily stocked quail preserves in Georgia is quoted:

"In view of the fact that not more than four quail were discovered in approximately 1100 pellets, marsh hawks can hardly be accused of making any serious inroads on the number of quail in the region. On the other hand, one or more cotton rats were found in 925 of these pellets. Since cotton rats destroy the eggs of quail, the marsh hawk is probably the best benefactor the quail has in the area, for it is actually engaged in reducing the numbers of these rodents. Remains of at least 14 snakes, most of which were colubrines, were discovered. These also are probably eaters of quail eggs" (*in* Stoddard, 1932, p. 209).

In California the marsh hawk is largely absent from the habitat occupied by quail.

BARN OWLS AND OTHER PREDATORY BIRDS

A few instances of the destruction of quail by barn owls where cover is inadequate have been reported from western Riverside County. However, since quail mortality from this cause appears to be small even in the region mentioned, and since the barn owl is known to be practically 100 per cent beneficial, it is recommended that no control measures be taken against this species.

Other hawks and owls, either by reason of their food habits or their rarity on quail range, are important to quail only as they serve to hold the rodent population in check. Their control will seldom or never be advisable.

MISCELLANEOUS

ANNUAL SHOOTABLE INCREASE

An attempt has been made on page 244, Part I, to work out a life equation for the California quail. A study of Fig. 14 shown there helps one to form an impression of the multitudinous small drains which slowly eat away the fall surplus until by the next breeding season the quail population has been reduced once more to about what it was the previous year. This seasonal upswing and gradual subsidence will occur regardless of whether or not the birds are hunted. The problem is: To what extent can we add the burden of hunting to all the other burdens of a given quail population?

One part of the answer to this question lies in the management of the covey along the lines indicated in the foregoing sections, so that as many as possible of these small unceasing drains are reduced (they can seldom be entirely stopped) to their smallest possible extent.

The other part of the answer is that *provided* cover, feed and water are amply adequate, we can shoot a fair proportion of the birds—more than would have perished by that time of year as a result of nature's toll in the absence of hunting—and yet rest assured that the remainder, because freed from competition with their fellows for food, can survive the winter with *less* than the loss which would have normally occurred if the area had not been hunted. The reason for the compensating, less-than-normal loss following hunting is discussed more fully on page 246, Part I.

Just how great a proportion of birds may be safely taken by the hunter will vary considerably with the locality and the particular season. As previously noted, it was estimated at 19 per cent in the unusually favorable area studied by the writer. Some regions with deficient food and cover will never be able to produce much of a usable surplus unless the environment is greatly improved. On the other hand, a few regions which have never been improved continue to produce a shootable increase year after year. This is because nature has accidentally provided an ideal combination of conditions in these places. In Europe the yearly estimate of the next season's shootable increase, which may run as high as 66 per cent, has been reduced to a fine art (Committee of Inquiry on Grouse Disease, 1911, p. 455), but methods for doing this in the United States—where the surplus will usually be much less—have yet to be developed.

METHODS OF RESTOCKING

As already mentioned, additional quail should never be introduced into an area unless it is known that the existing population has been markedly reduced by overhunting or similar cause. If the range is at capacity level the excess birds will either be reduced to starvation, picked off by natural enemies, or forced to move. If the range is not up to capacity it will usually be filled up by the natural increase of the resident stock during the first breeding season, unless the region has been heavily overshot.

The practice of introducing one subspecies of quail into the habitat of another subspecies is usually to be condemned upon the grounds of long-time, sound management. Although it is sometimes difficult to prove the point in cases where the native habitats of the two subspecies are similar, the inference even here is that each subspecific race of quail is most thoroughly adapted to its own region and would be at a disadvantage when introduced into the habitat of any other race. In cases where the differences are greater, the inferior powers of survival of the introduced stock are more easily seen. The fact that the quail inhabiting southern California and Mexico are markedly inferior in size and weight to those which inhabit northern California is of significance in this connection because the indications are quite conclusive that the small size of the southern birds would render them less well fitted to withstand the rigors of a northern climate than the larger native birds (page 249, Part I). Typical of the many fantastic and costly experiments which have been made in the past is the introduction of 500 Gambel quail, which are inhabitants of the arid deserts of the Southwest, into regions of intense cold and heavy snowfall such as Massachusetts and Pennsylvania (McLean, 1930, p. 44).

In cases where restocking is decided to be feasible, the discouraging tendency to wander away as a result of being liberated in a strange locality may be reduced to a minimum by releasing the birds gradually according to the method described by True (1933*b*, p. 249).

METHODS OF TRAPPING QUAIL

The following directions are for the benefit of those who are faced with the problem of capturing quail either when the birds are doing damage to crops or when they are so abundant as to warrant use for restocking areas where the supply has been depleted.

The Modified "Cock-and-Hen" Trap (Figs. 58, 59). This trap was used extensively by the writer and represents a type described by Stoddard (1932, p. 446), with some changes which were dictated by local conditions.

A modification suggested for this trap when used in California is an increase in height to 2½ feet, because in most parts of the state rabbits are a constant source of annoyance and damage by their habit of cutting large holes in the buffer cloth with their teeth. The increased height of the trap raises the buffer cloth out of their reach. It has also been found convenient to use a wood base at the *edge* only, as shown in Fig. 58, instead of using a solid wood bottom as described by Stoddard.

General specifications are as follows:

Sides, partitions, and *top* are ½" mesh hardware cloth.

Buffer cloth (to prevent head injuries) is ½" mesh cotton fish net rolled on two sticks of ¾" doweling until taut. The net may need to be laced to the trap sides here and there in addition.

Wire top of trap is merely hooked over sides so that it may be easily removed to repair buffer cloth if damaged by rodents.

Center compartment is used to hold a captured quail which serves as a lure for the others of the flock—at any season. A small door is provided for inserting and removing this decoy bird.

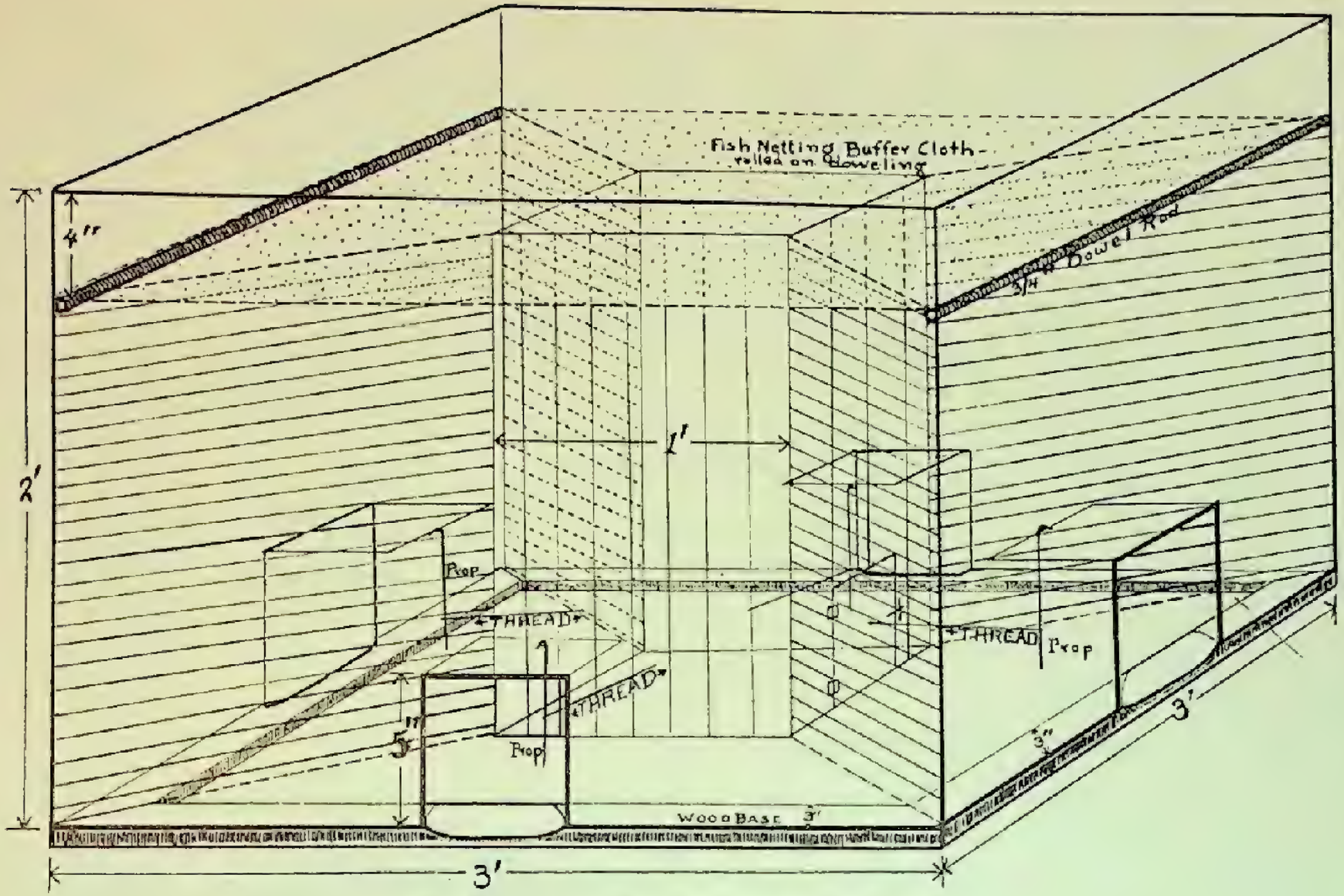

FIG. 58. "Cock-and-Hen" Trap, as described in text.

Bait (ordinary poultry "scratch feed") is always used, whether decoy present or not. It is scattered just beneath the thread which stretches from the vertical wire door prop to the back of the compartment.

Door prop is 5" long, with right-angle bend at end to support the hinged door. Quail feeding inside compartment bump thread while picking up grain, knocking down door prop.

Doorways framed with heavy wire for rigidity.

Sills whittled to a bevel, making ingress easy for the birds.

Bait is scattered on the proposed trap site several days before trap is installed. When quail have learned to come to bait, the trap is placed on the spot, propped up with sticks, the bait being scattered beneath it. When quail have got used to this, trap is lowered into place (wood base being flush with ground), doors are wired open, and bait placed inside. When quail become used to feeding inside (2-3 days) trap is set. As many as 35 may be caught the first day, the rest of the covey by the second day, usually.

Trap and *buffer*, painted with any greenish or blackish-brown paint for low visibility (the writer has used blue barn paint plus road dust and used crank case oil, resulting in an almost invisible greenish dirt color).

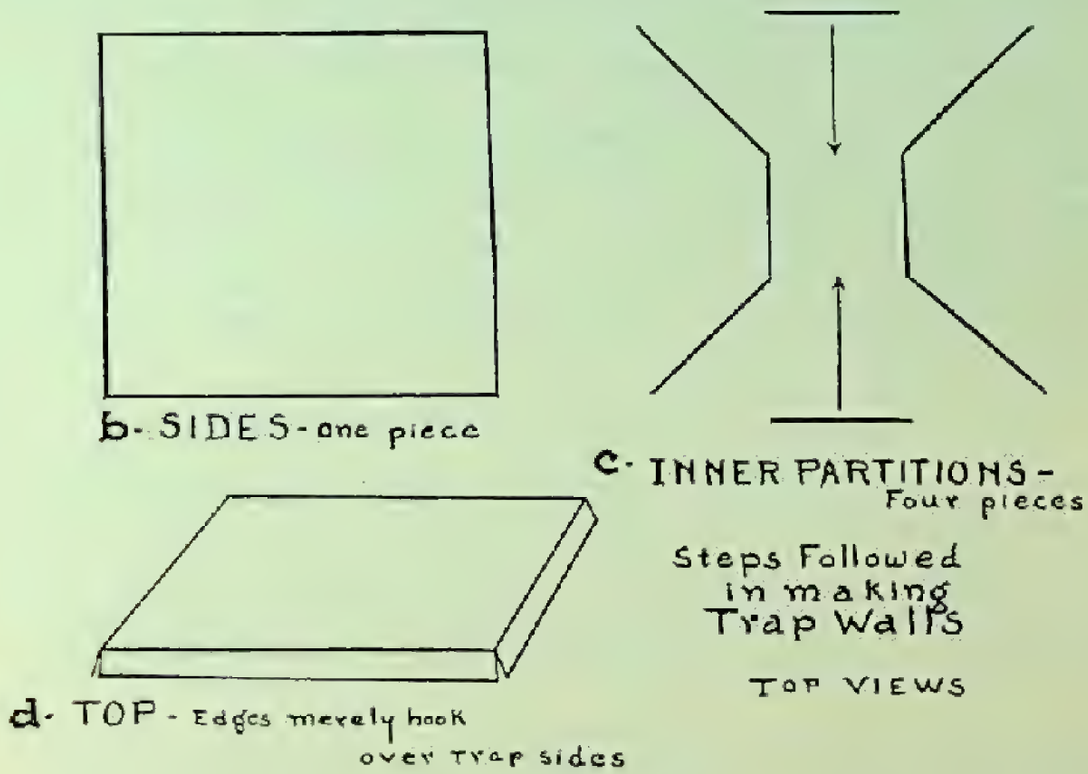
b- SIDES - one piece
c- INNER PARTITIONS - Four pieces
Steps Followed in making Trap Walls
TOP VIEWS
d- TOP - Edges merely hook over trap sides

FIG. 59. Parts of "Cock-and-Hen" Trap, as described in text.

INBREEDING

Field observations and banding studies made by the writer show that the likelihood of inbreeding among quail to any appreciable extent is exceedingly remote (page 210, Part I). The practice of scattering resident birds, or of bringing in birds from some distant locality merely to "improve the blood" is entirely unnecessary, and the same amount of energy expended in piling brush around an unduly exposed watering place, for example, would be vastly more productive.

In addition to being unnecessary to prevent inbreeding, the transplanting of birds from one locality to another is hazardous for the newcomers, because they are at a great disadvantage when trying to escape enemies or when searching for food and water in a strange locality,

and losses are very likely to occur. It would be a good thing if transplanting quail were more frequently regarded as a major operation associated with an inescapable death rate, for this is what it amounts to.

WEATHER AND EMERGENCY FEEDING

Although adverse weather conditions are beyond direct control, their effects may be mitigated to some extent. Where possible, in planning a quail refuge, nesting cover on well drained land should be encouraged at the expense of cover in places subject to flooding during rains. This procedure may result in the survival of many young which would otherwise be drowned in the event of unusually late spring rain storms.

In regions subject to considerable snowfall, such as northeastern California and the Sierran foothill region, quail are sometimes faced with starvation because of the burying of their usual food supply, and widespread losses have been recorded following unusually severe winters.

In the eastern United States, where winter quail food shortage is of more frequent occurrence, various emergency feeding methods have been evolved. Most of the feed put out for the eastern birds is corn, however, which would probably be rejected by the California quail, as previously mentioned (page 314). It is probable that bundles of small, unthreshed grains such as wheat, sorghum, and millet can be used instead of shocked corn for this purpose. Excellent directions for feeding quail and other game birds during periods of winter shortage are given by Grange and McAtee (1934, p. 35).

ECONOMIC RELATIONS AND CONTROL METHODS

The California quail is seldom a cause of economic damage because most of its diet is made up of weed seeds.

Damage to Grain Fields. Occasionally the birds acquire the habit of invading newly sown grain fields for their evening meal, and may clean up all the seed within 20 or 30 feet of cover around the entire field.

Much of this damage can be avoided if it is possible to remove all brush within 50 feet of the edge of the field, since the birds will then be afraid to venture out into the sown area to any extent.

If it is necessary to get rid of the quail in order to stop the damage, they can be trapped and removed to some other locality.

Damage to Lettuce, Grapes, and Other Succulent Crops. In certain parts of California, notably Salinas Valley, Monterey County, quail sometimes congregate at the edge of lettuce fields in large flocks in the summer months and clean up extensive sections adjacent to the brush. Since the damage ceases abruptly as soon as the winter rains commence, it is apparent that such invasions are caused by a shortage of natural water or of green feed. Accordingly, it is suggested that where it is not possible to clear away the brush from the margins of the lettuce fields, a plentiful supply of water (see page 319, for directions for installing) be provided in the brushy cover adjacent to the fields, and that several handfuls of poultry "scratch feed" or other

grain be scattered daily around the water. Since quail usually prefer grain to green feed, they may thus be induced to keep out of the lettuce.

The same control measures can probably be applied to damage caused by quail to grapes, but if it is necessary to remove the birds, they may be trapped, as mentioned above.

Benefits to Agriculture. Within the last few years there has been a tendency among investigators to depart from the traditional though unproven thesis that birds are of inestimable value to agriculture in checking insect pests and noxious weeds, and to stress instead the esthetic and recreational value of birds simply as birds, apart from any consideration of dollars and cents.

Ainslie (1930) has pointed out that birds are of subordinate importance in controlling insect pests as compared with parasitic and predatory insects. Moreover, it is now believed that the presence of weeds depends upon such factors as weather and the condition of the soil as it favors germination, rather than upon the loss or survival of any one season's crop of weed seed, so that the activities of birds in consuming weed seeds may have very little effect upon the weed population.

In agreement with such recent evidence are the results of an experiment conducted by the writer to test the effect of foraging quail upon a weedy area of limited size. The 35 by 120 foot inclosure previously described was, at the close of other experiments, continuously stocked for two years with a covey of quail which averaged eight in number, representing a concentration of 83⅓ birds per acre. This prolonged, abnormal concentration of birds resulted in a severe food shortage during the second winter, as shown not only by daily observation of the fruitless efforts at foraging made by the birds but also by their steady loss in weight until in a few cases death resulted.

Nevertheless, in spite of the constant intensive searching for weed seed carried on by the starving birds, the crop of weeds and grasses which appeared each spring was not visibly reduced either as to species or individuals. One reason for the failure of the birds to find all of the seeds was that their characteristic scratching tactics, regularly employed while feeding, covered up at least as much ground as was uncovered.

Esthetic Worth. Although quail may thus be regarded as more or less neutral from the standpoint of weed control, their intrinsic value ought not to be regarded as any less. Surely we have reached a stage of civilization where quail can be appreciated for their own sake—for their ringing calls in the cool gray hours of early morning, and for a hundred graceful and sprightly scenes along summer roads, on steep, chaparral-clothed slopes, or in the twilight of the autumn woods—rather than for the number of weed seeds which they may or may not destroy or the number of cents' worth of meat which they might be calculated to represent.

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FIFTH ANNUAL BLACK BRANT CENSUS IN CALIFORNIA

By JAMES MOFFITT

The census of black brant (*Branta bernicla nigricans*) taken on the bays along the California coast frequented by this species on February 10, 11 and 12, 1935, constitutes the fifth consecutive year in which such counts have been made. These tallies have been secured within a day or two of the same date in each year and mainly by the same observers, so the results are strictly comparative in all instances and in most cases, I believe, they are also highly accurate. Previous censuses have been reported upon by me in the October numbers of CALIFORNIA FISH AND GAME following each census.

Acknowledgment with thanks is hereby made for the services rendered by the cooperators, named later in this paper, who took the various counts this year. Most of these men have assisted with all five censuses. It will be noted that four of the cooperators are game wardens and it is a pleasure to mention their splendid assistance as well as the complete cooperation that the division itself has always given to this work.

A brief report of the individual 1935 censuses follows:

HUMBOLDT BAY

Captain of Game Wardens W. J. Harp took the 1935 brant census on this bay. He was assisted by Game Warden W. F. Kaliher. The following is Captain Harp's report under date of February 12, 1935:

"The annual black brant census was made on Humboldt Bay on February 11, by Warden Kaliher and myself. The weather was bad, a strong northwest wind was blowing with occasional showers. The tides were as follows: high tide, South Jetty, 5.45 a.m., 6.3 feet; low, 1.27 p.m., 0.4 feet. The bay was somewhat calm but a heavy sea was running outside the bay entrance. We left Fields Landing (South Bay) at 8.20 a.m. and circled the bay using an out-board motor and small skiff. From the landing we circled the bay to the east, south and west, keeping away from the shore line so as to not disturb the birds more than necessary. Before leaving the landing we could see and hear birds on most of the bay area as there were literally thousands of them. No doubt the heavy sea had driven the birds from the ocean into the bay which was the cause of the large concentration. It was impossible to make a bird by bird count as there was hardly a ten-acre-square area that did not contain birds. The heaviest concentration was along the south and west half of the bay. Warden Kaliher and I both concluded that there were at least 70,000 birds present on the South Bay.

"During the afternoon we circled the North Bay by automobile, using our glasses from different points. The tide being low, the birds were feeding along the two larger channels that divide North Bay. We concluded 35,000 brant was a conservative estimate for the birds on North Bay, making a total census for Humboldt Bay of approximately 115,000 brant. This estimate or census may seem large to those who have never experienced the sight of a real concentration of these birds on this bay, but having helped with the census on prior occasions and

observing these birds during past seasons just before their northern migration, I feel this estimate is very conservative. (Signed) Wm. J. Harp."

It is apparent from the above report that an unusually large concentration of brant was present this census time on Humboldt Bay, similar, perhaps, to the numbers encountered by the first census takers in 1931 when a rather unsatisfactory estimate was secured (see CALIFORNIA FISH AND GAME, vol. 17, p. 400). It should be noted (see table p. 347), that only moderate numbers of brant were found on Humboldt Bay in the three intervening counts, and that in the years of the heavy concentrations on this bay brant populations remained relatively normal in our other bays. It is difficult to find a reason for the large assemblages of brant on Humboldt Bay in 1931 and 1935 from the data at hand. I do not believe that the heavy winter last year was responsible, for the winter of 1930-1931 was a light one. Residents along Humboldt Bay state that large gatherings of brant occur annually on the bay, but sometimes maximum numbers are not reached until March or even April. The birds usually remain on this bay in large numbers for some time after maximum concentration for the year is reached, before finally leaving on the northern migration.

It is my belief, not yet proven by observations, that the large, early concentrations on Humboldt Bay may occur in years when there is a light crop of eel grass (*Zostera marina*) in Lower California waters. I am convinced that most of our Pacific Coast brant fly south to Mexican bays and lagoons in early fall and that the birds which begin to appear on California bays in late November and do not reach maximum numbers until mid-February or later, reach us from the south. This matter has been mentioned by me in previous brant census reports with data supporting the theory. An additional piece of information furthering my premise recently came to my attention in reading W. H. Dall's statement in the Proceedings of the California Academy of Sciences (vol. 5, 1874, p. 275), where he states that on his passage to California from Alaska, in the latter part of October (1873), enormous flocks of brant were seen about 100 miles off the coast of California, flying south and frequently alighting on the water near the ship. If this is the case it seems logical to believe that the brant will leave Lower California waters earlier in years when subnormal food exists for them there (after they have depleted the food supply in the Mexican bays), and since their natural food is said not to grow farther south, they must come north to our bays for sustenance. It is, then, natural to expect most of them to visit our largest bay (Humboldt) supporting their favorite food. This matter serves to emphasize the need for extending our brant census work into Lower California, which I have advocated for several years, before a thorough understanding of the species' winter life history can be obtained.

Letters from Captain Harp preceding the 1935 census indicate that the large concentration of brant did not reach Humboldt Bay many days in advance of the census date. Captain Harp, in a letter dated February 2, 1935, stated that there were "quite a number of brant on the bays at this time, at least ten thousand on North Bay and many more on South Bay." On December 20, 1934, Harp advised that the first brant for the season were noted on North Humboldt Bay on

November 11, a few small flocks, and that there were about two thousand of these birds on this bay by December 1, but not so many brant on South Bay, nor was any noticeable increase in their numbers noted between December 1 and 20.

BODEGA BAY

Dr. J. M. Linsdale, University of California Museum of Vertebrate Zoology, took the brant census on this bay for the fourth consecutive year on February 11, 1935. The tides on Bodega Bay on that day were: high tide, 5.14 a.m., 5.4 feet; low tide, 12.58 p.m., 3.7 feet. Dr. Linsdale commented upon the present census as follows:

"The clouds cleared up just enough at about 9.30 in the morning for me to get one of the most satisfactory counts I have made on Bodega Bay. My total was 3700 brant. Repeated recounts of smaller groups of birds all tended to verify this first total. The birds were well scattered over the southern portion of the bay, although there were several groups of close to 500 individuals."

TOMALES BAY

The writer took the census on Tomales Bay for the fifth year, on February 11, 1935. Tides were: high, 5.29 a.m., 5.6 feet; low, 1.13 p.m., 0.2 feet. Weather conditions were unfavorable for securing an accurate count of the birds. A very strong northwest wind made heavy seas on the bay and the birds restless. The waves hindered progress in a small skiff with outboard motor, several times stopping the engine by washing over it. As a result, this year's census, though made in the usual way, must be regarded as less accurate than previous ones I have taken on this bay and I judge that the total of 6850 brant counted this year is probably not more than 80 per cent correct for the number of birds present that day.

I have, in former annual reports, given detailed information upon the time of arrival and increase in numbers of the brant on Tomales Bay, where I have spent considerable time in previous winters. This year, however, I was away from California in the fall and first visited Tomales Bay on December 15, 1934, when I found relatively few, not to exceed 1500 brant present. A week later I judged that there were 2500 brant on the bay and by December 29 there were twice this number. Maximum concentration seemed to be reached by the middle of January, or nearly a month earlier than usual, then the birds remained about constant in number until late April when the northward migration commenced.

My shooting on Tomales Bay last gunning season, although limited, tended to indicate a shortage of young brant in spite of the fact that the census later showed more than the usual total numbers in our waters. Our only successful hunt was on December 22 when 16 birds were bagged. Of these, only two, or 12½ per cent, were juvenile, or young of the year. My experiences on this bay in previous years have indicated that young birds normally average 40 to 45 per cent of the bag. This apparent shortage of young brant in the past winter is probably attributable to a heavy snowstorm, 18 inches at Point Barrow, that fell July 4, 1934, and, according to my friend C. D. Brower of that

place, killed many young waterfowl. Point Barrow is in the heart of the nesting grounds of this species, and since this storm is said to have been quite general over the surrounding country, it may well have destroyed a large portion of the year's brant crop.

DRAKE'S BAY

T. T. McCabe, Berkeley, again, for the fourth consecutive year, took the census on Drake's Bay, including Limantour Bay. This count was made on February 11, 1935, simultaneously with the Humboldt, Bodega and Tomales Bay censuses. Tides on Drake's Bay were approximately as previously noted for Tomales Bay. McCabe counted a total of 1995 brant this year, stating that the high wind which so interferred with my work on Tomales Bay likewise prevented him from getting an exact census; but he believes that his 1935 results are comparable with his 1934 census of this area for exactitude.

MORRO BAY

Game Warden F. W. Hecker and Dr. A. P. Marshall of San Luis Obispo, assisted by A. Silva of Morro Bay, took the census at this point between 8.30 a.m. and 12.30 p.m. February 12, 1935. Hecker reported upon the census as follows:

"The weather was calm, but some difficulty was encountered in counting due to the unusual activity of the birds. It was impossible to make an exact count of the largest flock of brant, which were congregated on the mud bank just south of the State Park Clubhouse. This flock was estimated by making an exact count of a section of the flock and then blocking off the remainder in similar sections. This was done by all three members of the counting party, and their individual estimates so closely approximated 4500 birds, that this figure is given, and is believed to be a correct, and slightly conservative figure.

"The count in Morro Bay totaled 7544 brant. Immediately after making the count in the bay, we proceeded up the coast, and found a flock of approximately 150 brant working in a kelp bed about one mile south of Piedras Blancas Lighthouse. (Signed) Fred W. Hecker."

This is the second year that Hecker and Dr. Marshall have taken the Morro Bay census. They assisted me with this work in 1934, when I showed them the manner in which I took the previous censuses, and they continued the same system this year, insuring uniform counts from this area.

MISSION AND SAN DIEGO BAYS

L. M. Huey, who has taken most of the censuses in this area, was in Mexico, hence unable to assist this year. The census was made by Dr. C. G. Abbott, Director of the San Diego Natural History Museum, Game Warden E. H. Glidden and Frank Seabold. Dr. Abbott and Glidden have assisted with previous censuses. This year two counts, yielding equal results, were taken two days apart. This fact seems to support proof to the belief that the brant are rather sedentary at this season, and also indicates an interchange of the birds between the two bays. Glidden's report follows:

"February 10, assisted by Mr. Frank Seabold of Mission Bay, a brant census was taken to correspond with the census date of 1934 on Mission Bay and San Diego Bay. The census was taken in the usual manner with the aid of a motor boat and field glasses. The report follows:

Mission Bay

"Three separate groups of brant were counted totaling 36 birds. There was also counted 12 white-fronted geese. We mention this fact as geese are rather unusual in this part of the county, especially on the bays.

"Tides for the day were: low water, 10.24 a.m., 0.8 feet; high water, 4.54 p.m., 2.7 feet.

"The census was taken in the morning after the mudflats became visible.

San Diego Bay

"One group of brant containing 28 birds was noted feeding on the mudflats west of the old Potash Plant on the east side of the bay. No other brant was seen. Total count of brant on Mission and San Diego bays was 64 birds.

"February 12, assisted by Dr. Clinton G. Abbott of the San Diego Natural History Museum and Mr. Seabold, the second census was taken with results as follows:

Mission Bay

"One group of brant consisting of 9 birds was all to be seen after covering the bay as on February 10. At this time there was also counted 26 white-fronted geese, which was a surprise to Dr. Abbott and worthy of mention. Tides for the day were: high water 4.4 a.m., 5.1 feet; low water, 12.47 p.m., 0.1 feet. Census taken in the morning as on February 10.

San Diego Bay

"One group of brant containing 55 birds was seen on the mudflats as on February 10. Although we covered the bay thoroughly no other brant was seen. Total count of brant of Mission and San Diego bays was 64 birds.

"It is coincident that the count should tally on February 12 with that of February 10. (Signed) E. H. Glidden."

The following table summarizes the results of the five annual brant censuses:

TABLE 1

Locality	*1931*	*1932*	*1933*	*1934*	*1935*
Humboldt Bay	Unsatisfactory	29,415	5,000	16,860	115,000
Bodega Bay	None made	3,200	977	1,298	3,700
Tomales Bay	9,445	6,285	7,409	5,565	6,850
Drakes Bay	None made	2,108	318	2,189	1,995
Morro Bay	4,493	2,938	None made	3,895	7,544
Mission Bay	71	No birds	115	154	9
San Diego Bay	No birds	No birds	No birds	7	55
Totals	Incomplete	43,846	13,819	29,968	135,153

It is apparent from the above table that the total number of brant occurring in California at census taking time, fluctuates widely from year to year. It seems probable, judging from the large and accurate censuses obtained on Tomales and Morro Bays in 1931, and the rather unsatisfactory but also large one from Humboldt Bay in the same year, that a concentration similar to the 1935 one existed in our waters that year. In any event the census work over the five-year period indicates no reduction in numbers among these birds.

What a pity, then, that California brant shooters, who have always had to work harder for their birds than duck hunters, are practically legislated out of any chance of securing sport this season by the new federal regulation prohibiting waterfowl shooting from a boat or blind more than 100 feet from shore. One need know only the rudiments of brant lore to appreciate how these birds shun the shore line; in fact, they often fly long distances around narrow promontories in preference to taking the shorter, more hazardous overland crossings. I know of no instances of excessive brant kills having been made under existing game laws in previous years. The species numbers are proven to be holding up well. It would, therefore, seem unjust to penalize the shooters further than the shortened season and reduced possession limit will provide. Certainly the regulation prohibiting shooting more than 100 feet from shore will keep many hunters from even trying for brant this winter with the result that some of them will gun for ducks instead, which can stand much less hunting at this time due to the critical position of many species.

The division was able to secure some interesting information on the occurrence of black brant along the coast of Lower California last winter through the alertness of R. E. Croker of the California State Fisheries Laboratory. Croker volunteered the letter, quoted in full below, for inclusion in this paper. It would seem that other opportunities to secure much needed information regarding the brant population of these waters should develop in the case of future cruises of the *Bluefin* (The Division's Commercial Fisheries boat) to Mexican waters. If so, I earnestly plead that someone be instructed to observe the brant.

Croker's letter follows:

"In case you are continuing the black brant census this year you may be interested in some observations made in Lower California recently by Mr. E. Hyde, mate of the M. V. *Bluefin*, and myself.

"The boat spent several days at Turtle Bay (Port San Bartolome) engaged in tuna tagging. We noticed brant in the bay, and on February 6, 1935, attempted to estimate their numbers. We decided that a total of 1500 could not be far from wrong. The numbers seemed to remain constant until we left on the 9th.

"On February 10th we were forced to take shelter at San Quentin Bay. Mr. Hyde and I spent all day cruising around the bay and decided that there were probably 2000 brant present. The brant were much scarcer than they were last December when the *Bluefin* was at San Quentin, according to Mr. Hyde.

"The foregoing figures are very rough approximations, to be sure, but I trust that they may be of some value. (Signed) Richard S. Croker."

It is interesting to note that Hyde's impression that brant were much scarcer at San Quentin Bay on February 10, 1935, than in the previous December, is in accord with my contention that the birds migrate northward to California around the first of the year.

In answer to many requests as to whether or not I plan to continue with these annual brant censuses, I will state that if the cooperators are willing to continue, I should like to carry to completion my original plan to take the counts annually over a ten-year period. Thus the job is only half done. It seems necessary to extend the operations over this long a time in order to get the average from a number of seasons, so great are the annual fluctuations (see table, p. 347). The longer I continue with this work the stronger I am impressed with the necessity for extending our operations into Lower California before really satisfactory results can be expected. In the last report (see CALIFORNIA FISH AND GAME, vol. 20, 1934, p. 364), I plead for assistance in this direction but I have received no response to date.

Last fall when I was in the U. S. Bureau of Biological Survey offices in Washington, D. C., I laid what I believe to be the most practical plan to procure a nearly simultaneous census of Lower California brant before Chief J. N. Darling and other officials in the Survey. Briefly, it was for the Bureau to apply for permits from the Mexican Government for a United States Navy seaplane to visit all Lower California bays and lagoons bordering on the Pacific Ocean for the purpose of counting the brant. I also asked the bureau to apply to the Navy Department for the loan of a plane and crew for a week for this purpose. I hoped to be able to accompany the plane, or to have some Biological Survey biologist do so, and to count the brant on the bays from a collapsible canvas boat with outboard motor that would be carried in the plane. I wrote Chief Darling in detail in this regard later, hoping that the plan might be carried out last February. He referred my letter to F. C. Lincoln who replied that although interested in and in complete accord with my project, the Bureau, on account of the critical duck situation, was not in a position to assist with a Lower California brant census last February. This I regretted very much indeed, especially since my plan would not have cost the Bureau any expense save making the necessary arrangements through the State and with the Navy departments.

I may again request cooperation from the Biological Survey in a Lower California brant census next February. In case I find that they will again be unable to assist, I appeal to any interested California sportsman owning a yacht or preferably a seaplane, to contact me in this regard. I believe that a seaplane is by all means the most efficient medium through which to contact the many isolated bays along this great coast line within so short a span of time as to preclude much shifting of brant populations. A fast ocean going yacht or motor vessel would be the next best mode of transportation as it is impossible to reach the shore on the Pacific side of the peninsula much south of San Quentin Bay by road.

May I also appeal to any sportsmen or naturalists who may incidentally visit Lower California bays when the brant are there, to kindly provide me with such notes on the species as they may be able to procure. So little is known about these birds occurrence to the south of us, and it apparently has such a direct bearing on our brant population, that any information, however meager, will be valuable and most gratefully received.

Last year I published the results of a rather complete census of brant made in the State of Washington, coincident with our 1934 census, and of a less complete count made along the Oregon coast. This year I made no attempt to secure similar censuses after I learned that there was no prospect of having observations made in Lower California. If it is ever possible to arrange for a thorough census in Lower California, it will not be difficult to line up cooperators to count the brant from British Columbia southward, in which event a complete census might be secured of all brant wintering on the eastern shore of the Pacific Ocean.

September 3, 1935.

CALIFORNIA FISH AND GAME

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All material for publication should be sent to J. O. Snyder, Division of Fish and Game, 450 McAllister Street, San Francisco, California.

Vol. 21 OCTOBER, 1935 No. 4

REPORTS

STATEMENT OF INCOME

July 1, 1934, to June 30, 1935, of the Eighty-sixth Fiscal Year

FISH AND GAME PRESERVATION

Current Year:		
License sales—		
Angling licenses, 1934	$346,409 50	
Angling licenses, 1935	82,573 00	
Commercial hunting club licenses, 1934-35	1,225 00	
Commercial hunting club operators' licenses, 1934-35	265 00	
Deer tags, 1934	108,919 00	
Deer tags, 1935	4 00	
Fish breeders' licenses, 1934	25 00	
Fish breeders' licenses, 1935	330 00	
Fish importers' licenses, 1934	35 00	
Fish importers' licenses, 1935	85 00	
Fish packers' and wholesale shell fish dealers' licenses, 1934-35	930 00	
Game breeders, licenses, 1934	115 00	
Game breeders' licenses, 1935	977 50	
Hunting licenses, 1933-34	3,931 50	
Hunting licenses, 1934-35	315,593 34	
Hunting licenses, 1935-36	27 00	
Kelp licenses, 1934	20 00	
Kelp licenses, 1935	30 00	
Market fishermen's licenses, 1934-35	28,790 00	
Market fishermen's licenses, 1935-36	24,920 00	
Trapping licenses, 1934-35	1,681 00	
Total license sales		$916,885 84
Other income:		
Court fines	$36,400 42	
Fish packers' tax	305,386 08	
Fish tag sales	2,556 60	
Game tag sales	137 25	
Importers' contributions	315 00	
Interest on bank balances	6,201 93	
Kelp tax	99 77	
Lease of kelp beds	1,309 20	
Miscellaneous sales	3,603 82	
Publication sales	546 45	
Total other income		$356,555 52
Prior year—85th:		
Dividends, California National Bank	$10,545 00	
Dividends, Trinity County Bank at Weaverville	170 50	
Total prior year		$18,723 58
Grand total Fish and Game Preservation Fund		$1,254,717 78
Revenue for the General Fund (part of)		
Unclaimed checks and deposits		168 15
Grand total of all funds		$1,254,885 93

STATEMENT OF EXPENDITURES

For the Period July 1, 1934, to June 30, 1935, of the Eighty-sixth Fiscal Year

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Administration:					
Executive	$6,754 83				$6,754 83
Clerical and office	5,520 00	$1,013 85	$267 91	$52 49	6,854 25
Printing Fish and Game Magazine		1,778 05			1,778 05
Printing, general		3,639 61			3,639 61
Automobiles		487 53	440 90	1,527 43	2,455 86
Traveling			2,084 36		2,084 36
Postage			4,300 78		4,300 78
Telephone and telegraph			3,841 68		3,841 68
Freight, cartage and express			835 00		835 00
Rent			12,991 22		12,991 22
Accident and death claims			6,183 28		6,183 28
Accounting pro rata	5,661 90				5,661 90
Legal			2,907 75	24 00	2,931 75
Premiums on Bonds			50 00		50 00
Publicity			1,179 65		1,179 65
Pro rata General Fund-Expense, Chapt. 923-33			5,092 19		5,092 19
Total administration	$17,936 73	$6,919 04	$41,674 72	$1,603 92	$68,134 41
Bureau Education and Research:					
Clerical and office	$1,020 00	$13 04	$28 62		$1,961 66
Automobiles		584 66	129 94		714 60
Traveling			2,428 66		2,428 66
Photography		11 84	72 93		84 77
Library	1,080 00	19 45	67 67	$188 65	1,355 77
Research	3,000 00	93 69	38 90	12 30	3,144 89
Publicity	1,381 84		157 87		1,539 71
Total Bureau Education and Research	$7,381 84	$722 68	$2,924 59	$200 95	$11,230 06
Bureau Patrol and Law Enforcement:					
Chief and assistants	$11,100 00				$11,100 00
Clerical and office	3,180 00	$28 20	$63 50	$76 12	3,347 82
Automobiles		31,259 21	13,298 80	14,217 43	58,775 44
Traveling			43,545 21		43,545 21
Postage			670 66		670 66
Telephone and telegraph			1,916 87		1,916 87
Freight, cartage and express			9 61		9 61
Rent			758 21		758 21
Captains and wardens	185,306 00	972 39	1,004 70	26 51	187,309 60
Launches		1,744 82	1,090 01	310 27	3,145 10
Fish planting	4,620 00	645 00	1,890 74	1,289 85	8,454 65
Premiums on bonds			445 00		445 00
Cooks	1,016 12				1,016 12
Commercial fisheries patrol:					
Chief	2,760 00				2,760 00
Captains and wardens	13,227 10	29 30	15 60	12 52	13,284 52
Launches	11,516 52	8,364 03	5,174 07	323 16	25,377 78
Fish cannery inspectors, seasonal	8,005 31				8,005 31
Traveling			5,301 90		5,301 90
Rent			829 00		829 00
Automobiles		940 71	498 91		1,439 62
Temporary help	408 05				408 05
Total Bureau Patrol and Law Enforcement	$241,139 10	$43,983 72	$76,521 79	$16,255 86	$377,900 47
Bureau Commercial Fisheries:					
Chief and assistants	$13,620 00				$13,620 00
Clerical and office	9,600 00	$62 50	$85 78	$179 22	9,927 50
Automobiles		644 59	307 04	454 12	1,405 75
Traveling			5,995 45		5,995 45
Telephone and telegraph			698 42		698 42
Freight, cartage and express			201 95		201 95
Rent			140 34		140 34
Heat, light, water and power			383 05		383 05
Hydro Biological Survey, Monterey Bay			900 00		900 00
Research	2,280 00	69 07	27 52	248 40	2,624 99
Laboratory	23,029 34	1,007 55	1,234 32	559 67	25,830 88
Statistics		1,141 28	2,071 50	864 72	4,077 50
Temporary help	275 87				275 87
Fish cannery research			5,000 00		5,000 00
Total Bureau Commercial Fisheries	$48,805 21	$2,924 99	$17,045 37	$2,306 13	$71,081 70
Less: Indirect abatements deer tag tabulation			$328 60		$328 60
Total	$48,805 21	$2,924 99	$16,716 77	$2,306 13	$70,753 10

STATEMENT OF EXPENDITURES

For the Period July 1, 1934, to June 30, 1935, of the Eighty-sixth Fiscal year—Continued

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Bureau Fish Culture:					
Chief and assistants	$7,260 00	$2 89	$5 00		$7,267 89
Clerical and office	5,372 90	25 09	12 25	$73 82	5,484 06
Automobiles		8,015 18	3,417 11	8,925 41	20,357 70
Traveling			8,128 78		8,128 78
Postage			222 68		222 68
Telephone and telegraph			1,122 03		1,122 03
Freight, cartage and express			932 79		932 79
Rent			3,399 59		3,399 59
Heat, light and power			1,787 61		1,787 61
Hatcheries	109,097 20	72,637 70	879 24	1,405 16	184,019 30
Fish cars	3,540 00	280 35	2,595 94		6,416 29
Blue printing			114 53		114 53
Cooperative research	2,144 20	825 52	1,099 08	264 74	4,333 54
Temporary help	1,619 34				1,619 34
Fish Hatchery assistant, seasonal	25,340 35				25,340 35
Hydraulic engineering	2,400 00	61 29	987 47	49 50	3,498 26
Special field	8,139 05	57 25	9 40	19 35	8,225 05
Fish rescue:					
Miscellaneous supplies		55 96		8 54	64 50
Heavy truck mileage			336 51		336 51
Travel			1,807 85		1,807 85
Rent and water service			118 00		118 00
Motorized equipment		199 80	38 13	551 25	789 48
Chief and assistants	2,310 00		235 53		2,545 53
Total Bureau Fish Culture	$107,223 04	$82,161 03	$27,249 82	$11,297 77	$287,931 66
Bureau Game Propagation:					
Chief and assistants	$5,460 00				$5,460 00
Clerical and office	840 00				840 00
Automobiles		$910 20	$353 20	$963 60	2,227 06
Traveling			2,175 82		2,175 82
Postage			26 67		26 67
Telephone and telegraph			202 65		202 65
Freight, cartage and express			17 58		17 58
Heat, light, water and power			2,112 01		2,112 01
Maintenance	13,296 00	10,075 17	265 78	6 34	23,643 29
Temporary help	445 70				445 70
Quail trapping and expansion of quail program	4,620 00	1,263 98	2,527 03	16 29	8,427 30
Purchase of quail and pheasants		4,134 60			4,134 60
Total Bureau Game Propagation	$24,661 70	$16,383 95	$7,080 74	$986 29	$49,712 68
Bureau Game Refuges:					
Chief and assistants	$8,499 96				$8,499 96
Clerical and office	1,920 00	$11 83	$11 50		1,943 33
Automobiles		554 00	408 80	$702 94	1,666 04
Traveling			4,840 26		4,840 26
Freight, cartage and express			4 88		4 88
Blue printing			4 18		4 18
Research			328 60		328 60
Lion hunters	5,464 00				5,464 00
Refuge posting	900 00				900 00
Predatory animal control			6,450 00		6,450 00
Refuge maintenance	8,155 32	3,178 86	3,661 90	1,650 48	16,646 56
Predatory animal hunters and trappers, seasonal	6,000 00				6,000 00
Temporary help, seasonal	3,717 50				3,717 50
Total Bureau Game Refuge	$34,656 78	$3,745 59	$15,710 12	$2,353 42	$56,465 91
Bureau Licenses:					
Clerical and office	$13,140 00	$130 51	$14 45	$93 79	$13,378 75
Printing, licenses and applications		2,571 34			2,571 34
Traveling			413 62		413 62
Postage			1,058 08		1,058 08
Freight, cartage and express			202 96		202 96
Premiums on bonds			1,174 54		1,174 54
Identification License buttons		9,011 69			9,011 69
Total Bureau Licenses	$13,140 00	$11,713 54	$2,863 65	$93 79	$27,810 98
Total eighty-sixth fiscal year expense paid from support appropriations	$554,944 40	$168,554 54	$191,342 20	$35,098 13	$949,939 27

STATEMENT OF EXPENDITURES

For the Period July 1, 1934, to June 30, 1935, of the Eighty-sixth Fiscal year—Continued

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Prior Year Expense for Support, Eighty-fifth Fiscal Year					$17,437 33
Total Eighty-fifth and Eighty-sixth Fiscal Year Expense Paid From Support Appropriations					$967,376 60
Special Items:					
Eighty-sixth Fiscal Year:					
License commissions			$39,586 99		$39,586 99
Construction, Russian River jetties, Chap. 989-33			504 27		504 27
State Fair and other exhibits		$2 64	71 31		73 95
California Code Commission for expenses, Chap. 645-33			3,362 59		3,362 59
Electro Metals Co. claim, Chap. 599-31			13,750 00		13,750 00
Total Eighty-sixth Fiscal Year		$2 64	$62,275 16		$62,277 80
Eighty-fifth Fiscal Year:					
License commissions				$315 65	
Construction Russian River jetties, Chap. 989-33				30 00	
Claim of Chief Accounting Officer of Dept. Finance, Chap. 991-33				670 00	
Total Eighty-fifth Fiscal Year					$324 35
Eighty-fourth Fiscal Year:					
Expenditure for reimbursing bank account on account of failure of California National Bank, Dept. of Finance, Chap. 141-33					$37,090 19
Total Special Items					$24,863 26
Permanent Improvements:					
Construction, improvements and equipment:					
Eighty-sixth fiscal year	$5,682 50	$4,737 92	$8,047 10	$4,528 08	$22,995 60
Eighty-fifth fiscal year					46 32
Total Permanent Improvements					$23,042 01
Bureau of Commercial Fisheries, Chapter 825-33, Fresh Fish Marketing:					
Eighty-sixth Fiscal Year:					
Chief and assistants	$6,223 49				$6,223 49
Clerical and office	1,320 00	$192 00		$6 35	1,518 35
Printing		4,983 33			4,983 33
Automobile		221 90	$133 23	659 46	1,014 68
Traveling			2,715 24		2,715 24
Postage			1,389 50		1,389 50
Telephone and telegraph			6 85		6 85
Freight, cartage and express			649 81		649 81
Rent			95 23		95 23
Exhibits		323 25	2,352 40		2,675 65
Temporary help	292 63				292 63
Pro rata Fish and Game administration		271 05		2,984 82	3,255 87
Total Eighty-sixth Fiscal Year	$7,836 12	$5,991 62	$7,342 26	$3,650 63	$24,820 63
Eighty-fifth Fiscal Year					$11 55
Total Bureau of Commercial Fisheries, Chapter 825-33, Fresh Fish Marketing, Eighty-fifth and Eighty-sixth Fiscal Years					$24,809 08
Contributions to Retirement System					$17,168 51
Total from Current Biennium					$1,057,259 46
Prior Biennium Appropriations:					
Eighty-fifth Fiscal Year:					
Permanent Improvements:					
Construction, improvements and equipment					$583 19
Eighty-fourth Fiscal Year:					
Support					$853 65
Total from Prior Biennium Appropriations					$270 46
Grand Total Proprietary Group					$1,057,529 92

HUNTING ACCIDENTS, 1934

Number of persons killed	37
Number of persons wounded, not killed	88
Number of self inflicted accidents—	
Fatal	24
Non-fatal	35
Number of accidents inflicted by others—	
Fatal	13
Non-fatal	53
Occurred while hunting large game (deer, bear, etc.)—	
Fatal	6
Non-fatal	10
Hunting rabbits, ducks, doves, etc.—	
Fatal	10
Non-fatal	19
Hunting coyotes, skunks, etc.—	
Fatal	4
Non-fatal	2
Hunting, game not given—	
Fatal	17
Non-fatal	57

	Total	Fatal	Non-fatal
Occurred while hunting:			
Ducks	8	0	8
Quail	10	1	9
Doves	3	2	1
Deer	17	7	10
Rabbits	12	12	0
Squirrels	1	1	0
Pheasants	1	1	0
Skunks, etc.	6	4	2

Many above accidents were caused by children, and through pulling guns from cars, through fences, etc. Three deaths were from falls while hunting.

SEIZURES OF FISH AND GAME

April, May, June, 1935

Game:	
Bear hide	1
Bear meat, pounds	1
Deer	3
Deer meat, pounds	488
Doves	10
Geese, mudhens	19
Pheasant	5
Quail	7
Rabbits	5
Shorebirds	7
Mountain sheep horns, set	1
Fish:	
Abalones	593
Barracuda, pounds	510
Bass, Striped	432
Bass, Black	40
Catfish, pounds	117
Caviar, pounds	24
Clams	1,967
Cockles, pounds	7
Crappie, Sunfish	194
Halibut, pounds	600
Lobsters	489
Lobsters, pounds	1,216
Perch, pounds	506
Perch	35
Salmon	1
Shad, pounds	350
Sturgeon, pounds	100
Trout	346
Trout, pounds	150
Yellowtail, pounds	130

6—25634

CALIFORNIA FRESH FISH LANDINGS* FOR APRIL, MAY AND JUNE, 1935

Compiled by Division of Fish and Game, Bureau of Research and Engineering

Species	Region 10, Del Norte	Region 20, Eureka	Region 30, Sacramento	Region 40, San Francisco	Region 50, Monterey	Region 60, Santa Barbara	Region 70, Los Angeles	Region 80, San Diego	Total pounds
Anchovy	22			14,225	8,010		22,400		45,557
Barracuda						1,516	750,142	54,917	806,575
Cabezone					2,468				2,468
Cabrilla							60,060	33,414	93,474
Carp			30,172				22,136		52,308
Catfish			36,348						36,348
Corbina, Mexican							53,460		53,460
Cultus, Pacific	2,509	42,878		158,970	21,828	203	8		226,396
Eel, Moray				20					20
Flounder, Starry				201,669	839				202,508
Flying Fish							19,614		19,614
Grouper							9,421	1,669	11,090
Hake				25,684	52		2,236		27,972
Halibut, California				958	12,881	65,750	231,696	113,136	424,421
Halibut, Northern	1,420	336,379		70,244					408,043
Hardhead			27,503						27,503
Herring, Pacific					725				725
Kingfish				4,328	50,606		138,010	1,559	195,403
Mackerel, Horse					8,497		4,127,521	1,454	4,137,472
Mackerel, Pacific					142,122	709	26,870,196	3,772,318	30,785,435
Mullet							2,177		2,177
Perch	44	3,157		20,019	19,896	2,871	362	5,116	5,478
Pike			454				7,136		53,123
Pompano, California					180		169		454
Rock Bass						7,840	41,699	66,214	349
Rockfish	2,521	31,458		225,692	544,339	70,107	400,153	141,792	115,753
Sablefish	579	153,942		455,052	99,752	1,678	200,876	2,973	1,416,062
Salmon	13,837	498,001	106,713	12,585	175,949		15		914,852
Sand Dab				102,782	9,831		2,545		807,160
Sardine				1,023,618	438,080	5	23,158	2,766	205,158
Sculpin						316	19,179	2,216	1,487,627
Sea-bass, Black							130,905	35,480	21,711
Sea-bass, Short-fin								2,901	166,385
Sea-bass, Totuava							172,643		2,901
Sea-bass, White				26	79	11,995	302,706	1,745	172,643
Shad			1,512,284	165	30				316,551
Shark				5,546		11,577	149,290	14,364	1,512,479
Sheepshead						2,297	24,455	146	180,777
									26,898

Skate				45,858	7,493		2,626	7,738	63,715
Smelt		1,258		107,185	50,430	11,878	46,229		216,980
Sole		127		2,252,378	86,959	113,245	2,848	111	2,455,668
Split-tail			6,129						6,129
Striped Bass			302,891	13,019					315,910
Sucker			7,359						7,359
Swordfish, Broadbill							25,446	6,245	31,691
Swordfish, Marlin							455		455
Tomcod				20					20
Tuna, Albacore							366,910		366,910
Tuna, Bluefin							15,427,784	446,567	15,874,351
Tuna, Bonito							563,483	502,899	1,066,382
Tuna, Skipjack							615,458	2,709,446	3,324,904
Tuna, Yellowfin							7,825,502	14,360,286	22,185,788
Turbot				23,413	9,374		42		32,829
Whitebait	10,475	48,215		16,951	8,610				84,251
Whitefish						805	13,022	4,376	18,203
Yellowtail						10	578,702	2,280,047	2,858,768
Miscellaneous Fish		6,737	1,200	68,963	35	113	1,206		78,254
Crustacean:									
Crab	5,946	39,794		1,037,534	5,296				1,088,570
Crab, Rock							3,940		3,940
Lobster, Spiny							28,872	85,599	114,471
Prawn					1,124				1,124
Shrimp				875,508			250		875,848
Mollusk:				1,600	751,250	347,775	188		1,100,813
Abalone				20,334			6,474		26,808
Clam, Cockle		504		718					1,222
Clam, Gaper					1,625	39,108		13,425	54,158
Clam, Pismo				37,552					37,552
Clam, Soft-shell		1,996		526					2,522
Clam, Washington		238		11,655	17,921		3		29,817
Octopus				59,539					59,539
Oyster, Eastern				70,119	19,150				89,269
Oyster, Japanese				7,648					7,648
Oyster, Native				400					400
Snail					389,640		20,630		410,270
Squid									
Amphibia:									
Frog				20					20
Total pounds	37,353	1,164,084	2,031,053	7,062,043	2,885,980	689,987	59,315,338	24,070,910	97,857,957

*Fresh fish importations from foreign countries included in this table. See importation tables.

FISH CASES

April, May, June, 1935

Offense	Number arrests	Fines imposed	Jail sentences (days)
Abalones; small, closed season, overlimit	43	$1,131 00	25
Angling; no license	56	623 00	30
Barracuda; closed season	0	75 00	----------
Bass, Striped; illegal shipment of, overlimit, small	12	460 00	----------
Bass, Black; closed season, small	12	192 50	1
Catfish; selling in closed season, small	2	10 00	----------
Clams; overlimit, small, taking in clam refuge	37	615 00	200
Cockles; small	1	5 00	----------
Commercial fishing; no license	6	81 00	----------
Crabs; small	1	----------	----------
Crappie; Perch; closed season, overlimit	37	480 00	25
Fishing from dam	7	45 00	12½
Fishing near dam	22	187 50	2
Fishing closed stream	14	220 00	----------
Fishing near mouth of stream	6	100 00	----------
Halibut; small	1	----------	----------
Illegal fishing apparatus	6	133 00	6
Lobsters; closed season, possession undersized	10	40 00	60
Net; illegal	11	2,500 00	----------
Night fishing	4	30 00	1
Spears; illegal use of	1	----------	----------
Sturgeon; possession of	4	----------	----------
Trout; clubbing, dynamiting, closed season, overlimit	35	621 50	16
Yellowtail; selling local yellowtail to cannery	7	160 00	----------
Miscellaneous fish cases	9	430 00	30
Totals	353	$8,139 50	408½

GAME CASES

April, May, June, 1935

Offense	Number arrests	Fines imposed	Jail sentences (days)
Bear; closed	2	----------	10
Bird net; illegal	1	----------	----------
Deer; killing spike buck, closed season, killing fawn	26	$844 00	213
Doves; closed season	1	10 00	----------
Ducks, geese, mudhens; closed season	5	5 00	----------
Firearms in refuge	2	25 00	----------
Hunting without license	25	251 00	2
Hunting in refuge	2	20 00	----------
Illegal hunting license	2	25 00	----------
Night hunting	2	20 00	----------
Non-game birds; possession of	2	25 00	----------
Pheasants; closed season	9	155 00	12½
Pollution	1	100 00	----------
Quail; closed season	7	200 00	----------
Rabbits; closed season, netting of	5	96 00	27
Shorebirds; closed season	2	75 00	----------
Spotlight hunting	2	----------	180
Miscellaneous game cases	2	----------	----------
Totals	98	$1,851 00	444½

FRESH FISH IMPORTATIONS* BY POINT OF ORIGIN, APRIL, MAY AND JUNE, 1935

Compiled by the Division of Fish and Game, Bureau of Research and Engineering

Species	Gulf of California	West coast Lower California	International waters south U. S. boundary (definite origin unknown)	Mexican mainland and Central and South America	Japan	Total pounds
Barracuda		16,019				16,019
Cabrilla	32,532	58,498	2,444			93,474
Corbina, Mexican	53,460					53,460
Grouper		11,090				11,090
Halibut, California		114,115				114,115
Kingfish		25				25
Mackerel, Pacific		231,728				231,728
Mackerel, Spanish		2,177				2,177
Rock Bass		15,233				15,233
Rockfish		101,866				101,866
Sablefish		1,494				1,494
Sardine		2,706				2,706
Sculpin		1,741				1,741
Sea-bass, Black		163,113				163,113
Sea-bass, Totuava	172,643					172,643
Sea-bass, White		1,262				1,262
Shark		1,527				1,527
Sheepshead		146				146
Skate		1,501				1,501
Sole		6				6
Swordfish, Broadbill		170	84			254
Tuna, Albacore					366,910	366,910
Tuna, Bluefin		4,606,693	304			4,606,997
Tuna, Bonito		227,720				227,720
Tuna, Skipjack		846,410	1,990,882	487,612		3,324,904
Tuna, Yellowfin	228,776	2,383,675	14,091,204	5,482,048		22,185,703
Whitefish		8,332				8,332
Yellowtail		2,375,723				2,375,723
Crustacean:						
Lobster, Spiny		85,599	28,872			114,471
Mollusk:						
Clam, Pismo		13,425				13,425
Total pounds	487,411	11,272,054	16,113,790	5,969,660	366,910	34,209,825

* These importations are included in table of landings.

FRESH FISH IMPORTATIONS* FROM FOREIGN COUNTRIES, FOR APRIL, MAY AND JUNE, 1935

Compiled by the Division of Fish and Game, Bureau of Research and Engineering

Species	Landed in Region 70, Los Angeles	Landed in Region 80, San Diego	Total pounds
Barracuda	1,005	15,014	16,019
Cabrilla	60,060	33,414	93,474
Corbina, Mexican	53,460		53,460
Grouper	9,421	1,669	11,090
Halibut, California	73,152	40,963	114,115
Kingfish		25	25
Mackerel, Pacific		231,728	231,728
Mackerel, Spanish	2,177		2,177
Rock Bass	1,515	13,718	15,233
Rockfish	11,449	90,417	101,866
Sablefish		1,494	1,494
Sardine		2,766	2,766
Sculpin		1,741	1,741
Sea-bass, Black	127,935	35,178	163,113
Sea-bass, Totuava	172,643		172,643
Sea-bass, White	218	1,044	1,262
Shark	250	1,277	1,527
Sheepshead		146	146
Skate		1,501	1,501
Sole		6	6
Swordfish, Broadbill	170	84	254
Tuna, Albacore	366,910		366,910
Tuna, Bluefin	4,576,298	30,699	4,606,997
Tuna, Bonito	1,350	226,370	227,720
Tuna, Skipjack	615,458	2,709,446	3,324,904
Tuna, Yellowfin	7,825,417	14,360,286	22,185,703
Whitefish	4,227	4,105	8,332
Yellowtail	174,938	2,200,785	2,375,723
Crustacean:			
Lobster, Spiny	28,872	85,599	114,471
Mollusk:			
Clam, Pismo		13,425	13,425
Total pounds	14,106,925	20,102,900	34,209,825

*Included in table of landings for Region 70, Los Angeles, and Region 80, San Diego.

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1933—ABSTRACT CALIFORNIA SPORTING FISH & GAME LAWS—1935

THIS ABSTRACT WILL BE VALID UNTIL 90 DAYS AFTER ADJOURNMENT OF THE 1935 LEGISLATIVE SESSION

OPEN AND CLOSED SEASONS

WHITE SQUARES INDICATE OPEN SEASON. NUMBERS IN SQUARES ARE OPEN DATES

GAME	DISTRICTS	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	BAG AND POSSESSION LIMITS, ETC.
DEER	1½										15			No Does, Fawns or Spike Bucks No Forked Horned Deer in Dist. 1¾ No sale of Venison or Deer Skins Two Bucks per Season except in 1½ where limit is one. See Notes 6-9-10-32
	2-2½-3									14				
	2½-4-4½							16		15				
	1-1½-4½-23-26								16	15				
Rabbits—Cottontail and Brush	ALL EXCEPT 4, 4½, 19, 21											15	15	15 per day. 30 per week. Season always open in 4, 4½, 19, 21
Bear, Fur Animals	ALL												28	See Note 7
Ducks, Geese, Jack Snipe, Mud Hens	ALL — FEDERAL LAW	See Note →												Federal regulations will be enforced in California and will be published as soon as announced by Federal authorities.
	ALL — STATE LAW	15												15 Ducks daily, 30 weekly, possession limit, 25 Snipe daily, possession limit. Open 8 Mud Hen limit, see note 4. See notes 9 to 11, incl.
Quail—Valley, Desert and Mountain	ALL EXCEPT 1½												15	Valley - Desert - Mountain Each Variety 10 per day. 10 in possession. 20 per week
	1½													
Dove	ALL EXCEPT 4-4½-4½													15 Per Day 15 in possession 30 Per Week
	4-4½-4½													
Pheasant											15			2 Male birds per day 2 in possession
											20			
Pigeon													15	10 per day. 10 in possession 20 per week

There is no open season on Elk, Antelope, Mountain Sheep, Sea Otter, Beaver, Tree Squirrel, Sierra Hare, Rail, Wood Duck, Swan, Shore Birds (except Jack Snipe), Grouse, Sage Hen, Imported Quail, Partridge, or Wild Turkey

FISH	DISTRICTS	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	BAG AND POSSESSION LIMITS, ETC.
Steelhead and all Trout (except Golden) Whitefish Unlawful to take trout in waters closed by Governor's proclamation	1-1½-2-2½-3-3½-4-4½-4½-15 Klamath River, Lake Alameda													Bag limit for taking and possession, 25 trout or 10 pounds and one trout. No Sale No Spearing For other restrictions See Notes 12-15-16-20 21-22-27-28 30-32 On this Card
	2½		28			30								
	23-25					16								
	Trinity River					15								
	See Note 22													
	1½-5 and Water Klamath River		28											5 Trout regardless of weight
			28											3 Trout regardless of weight
														3 Trout regardless of weight
Golden Trout	ALL EXCEPT 1—4½													20 per day. None under 5 inches Not more than 10 lbs. and one See Note 22
	1-4½ Except Kern River and Lake Alameda													
BLACK BASS	ALL EXCEPT 4½					29								15 per day No Black Bass under 9 in. No sale Hook and line only
	CLEAR LAKE													Clear Lake 10 per day
Sunfish	ALL					29								25 per day
Sacramento Perch and Crappie	ALL EXCEPT CLEAR LAKE					29								25 per day Hook and line only No sale
	CLEAR LAKE													10 per day
Striped Bass	ALL													Taken from Sacramento River Delta, closed January 1 to August 31th. Open within 17 miles, 5 per day, 5 at possession. Same to be taken from Suisun Bay. See Notes 19 and 21
Crabs	ALL EXCEPT 1-3-6-7-8-9							30					15	Season Districts 1-3-6-7-8-9 Oct. 1 to Aug. 15 See Note 23. None under 7 inches. No Female
Abalones		14			16									Only five found must be brought to shore alive in shell Angling license Required. See Note 26
Pismo Clams	17													None under 5 inches. No shipment. 15 per day Angling license Required. District 18a Closed
Spiny Lobster	ALL													For Sale of Meat. None under 10½ or over 14 inches See Note 23
GRUNION	ALL													

SALMON, See Note A. STURGEON, No Open Season (possession prohibited).

IT IS ALWAYS UNLAWFUL

NOTES

1. To hunt, kill, possess wild birds or mammals, to possess firearms, except under written permit from the Commission, in Dists. 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h, 1i, 1j, 1k, 1m, 1n, 1o, 1p, 1q, 1r, 1s, 1t, 2a, 2b, 3a, 3b, 3c, 3d, 3e, 3f, 3g, 3h, 4a, 4b, 4c, 4d, 4e, 4f, 4g, or General Grant Refuge, or Mt. Tamalpais Game Refuge, including Richardson Bay, or San Francisco Refuge, or Silver Lake Refuge (water fowl may be killed in 4a and 4e), or to hunt quail in Bolinas Quail Refuge, or to hunt or discharge firearms in Huntington Lake Refuge, San Leandro Bay Refuge, or Monterey Peninsula Refuge.

2. To hunt birds or mammals excepting predators without a hunting license. To hunt in areas closed by proclamation.

3. To possess any bird net or to net, trap or to hold protected game or birds of any kind, their nests or eggs except under written permit from the Commission.

4. To take more than 4 geese per day, 8 per week of all varieties, and 12 Canada geese and black sea brant. To take more than 25 mud hens per day, 50 per week. To have more than 1 daily bag limit of geese and mud hens in possession by 1 person in 1 day.

5. To take or kill nongame birds, except blue jay, butcher bird, English sparrow, sharp-shinned, Cooper or duck hawk, great horned owl, linnet, crow, black-billed magpie, white pelican, shag, and in Dists. 1, 2, 3, 4 and 4½, blackbirds.

6. To hunt deer without deer tag license. To fail to attach to horns of deer immediately on killing, properly filled out deer tag or at same time to send duplicate tag to Division. To carry deer into closed district without having deer tag countersigned, or to have untagged deer in possession. To fail to retain in possession during open season and for 10 days after, skin and portion of head bearing horns of deer killed and to produce upon demand. To use more than 1 dog to hunter in hunting deer or to allow dogs to run deer in closed season, or to possess doe or fawn skins, or deer skins not bearing evidence of sex.

7. To trap for profit without first procuring a trapping license bear, ring-tailed cat, coon, pine marten, skunk, fisher, wolverine, mink, river otter, fox or muskrat, or to kill same during closed season, except when destroying property. To interfere with traps of licensed trappers. To use saw tooth or spike-jawed traps for taking fur bearers.

8. To use any animal other than dog to stalk wild birds.

9. To shoot game from power boat, sailboat, auto, airplane, or to hunt waterfowl from scull boat in Dists. 8, 9, except on Wed. and Sun., or at any time in Dist. 12 or Napa River south of Edgerly Island, and in Mare Island Straits from the Napa River to Carquinez Strait, or to use shotgun larger than 10 gauge, or to possess an extension automatic or cane gun. To have in possession any device capable of or to be used in silencing the report of any firearm.

10. To shoot resident game between ½ hour after sunset and ½ hour before sunrise, or migratory game between sunset and ½ hour before sunrise. To use a spotlight in hunting game.

11. To drive game birds by means of auto, airplane, or power boat over shooters.

12. To hold game or fish longer than 5 days after close of season: venison 15 days.

13. To sell wild game, except cottontail and brush rabbits.

14. To make a false statement in applying for license. To fail to show license upon demand to any officer.

15. To take game or fish from one district to another when season is not open in both. (Special law for deer, trout and black bass.) Trout legally taken may be transported from open district into closed district by the consignor making an affidavit in duplicate setting forth his name, address, number of angling license and name and address of consignee. Original must be attached to shipment; copy left on file with officer before whom sworn. Trout may be shipped into closed district when accompanied by written statement to effect that trout were legal, signed by shipper, countersigned by agent to whom offered for shipment. Black bass legally taken may be transported from open district into closed district.

16. To ship wild birds, mammals, or fish except smoked or dried fish other than trout by parcels post, or in concealed packages or without a tag bearing name and address of consignee and consignor and contents, or to ship game out of State.

17. To operate a commercial hunting club without license.

18. To place obstructions in streams in Dists. 1, 1½, 2, 2½, 2¾, 3, 4, 4½, 23 and 25 that will stop or impede fish.

19. To sell striped bass taken with hook and line; to transport or carry striped bass out of State. To ship striped bass less than 20 in. in length or more than 10 lbs. in weight. To possess more than 5 shad per day between June 1 and Feb. 14.

20. To take trout other than with rod and line held in hand or with lure with more than 2 attractor blades or more than 3 hooks. To take trout except by angling in such manner as to cause trout to voluntarily take hook in its mouth.

21. To have in possession any fish spear or gaff (except landing gaff) within 200 feet of any lake or stream when unlawful to spear salmon.

22. To take trout in any lake within 200 feet of mouth of any stream from Oct. 31 to Aug. 1, or in that portion of any stream flowing into any lake in Dist. 23 within 2 miles from its mouth, upstream, from Oct. 31 to Aug. 1. To take golden trout in Cottonwood Lakes group, including South Fork Cottonwood Lakes group and ½ mile of stream below the lower lake in each of said groups, except from July 1 to Oct. 31.

23. To bring to shore crabs or lobsters in such condition that size can not be taken; or to ship or carry crabs out of Dists. 1½, 2½, 5, 6, 7, 8 or 9. To sell any crabs taken in Eel River or tributaries or to possess more than 10 crabs taken there or to take any between ½ hour after sunset and ½ hour before sunrise.

24. To take or possess in Dist. 3 salt water eels of less than 12 in. or more than 15 per day.

25. To take or possess cockles less than 1½ in. in diameter, or to take or possess more than 15 (Dists. 2 and 10) Washington clams or more than 10 horse clams or more than 30 razor or jackknife clams per day, or in Dists. 18, 19, 21 more than 15 lbs. of mussels per day. To take or possess any Pismo clams in Dist. 18 between ½ hour after sunset and ½ hour before sunrise, or to possess any clam digging implement in that district. To possess any clam digging implement in any clam preserve.

26. To take red abalones less than 7 in. in greatest diameter; green, 6½; pink, 6; black, 5; to dry abalones; to dive for abalones in Dists. 7, 15, 16, 17, 19, 20 and 20a; to take more than 10 per day or 20 per week in Dists. 7, 15, 16, 17, 19, 20 and 20a. To take more than 10 per day from shore in Dists. 7, 10 and 18; to take more than 10 black abalones per day in Dists. 15, 16, 17, 18, 19, 20, 20a, 21. To possess more than 10 per day in Dist. 2.

27. To fish for game fish without having an angling license.

28. To take game fish between 1 hour after sunset and 1 hour before sunrise in Dists. 1, 1½, 1¾, 2, 2½, 2¾, 3, 4, 4½, 4¾, 23, 25. To take striped bass by hook and line between sunset and sunrise.

29. To fish with nets except in commercial districts or to injure any legal net.

30. To fish through ice for any fish or to take fish in Dist. 14.

31. To place, cause to be placed, or discharge into any waters substances deleterious to fish or plant life.

32. To fish within 250 ft. of fishway or 150 ft. of upper side of fish screen, or lower side of dam, or to take fish except salmon within ½ mile of either side of spawning station, or any lake within ½ mile of spawning station when station is in operation.

33. To kill, injure or capture Cal sea lions in Dists. 19, 20, 20a.

34. To take invertebrates or marine plants in Hopkins Marine Refuge (Monterey Co.) or in that area between the west line of the property of the Scripps Institute and a line 1,000 feet west of low tide line (San Diego Co.).

35. To take more than 5 white sea bass from May 1 to June 30, or to take at any one time more than 5 under 28 in.

36. To take more than 30 lbs. of halibut under 4 lbs. each, or to take more than 5 barracuda less than 3 lbs. each.

37. To take frogs less than 4 in. in length measured from tip of nose to posterior end of body between hind legs, or to take or possess more than 24 frogs per day or 48 frogs per week.

NOTE A.—SALMON. Salmon can not be taken on spawning beds, or within 10 miles of spawn-taking station, or 3 miles north and south of mouth of Klamath River. All salmon boats must have landing net, and no Chinook less than 12, or silver less than 24 in. can be taken in ocean and Humboldt Bay Dists. Undersized salmon can not be gaffed or clubbed, or brought ashore in such condition that size can not be determined. Salmon may be taken with hook and line in any district when trout season for said district is open.

In Dist. 1, salmon may be taken with hook and line or spear between May 29 and Oct. 31, except (a) in Feather River from its mouth to mouth of the Yuba; (b) in American River from its mouth to Fair Oaks bridge. In Dist. 2, (c) in Russian, Napa and Navarro rivers; (d) in Eel River and (e) in tidewater in Dists. 2, 3 and 15, with hook and line from May 1 to last day of Feb., bag limit 2 per day. In Feather River between mouth of Yuba and Thermalito bridge, with hook and line between May 1 and Dec. 31, bag limit 2 per day. In San Joaquin River, from mouth to Mendota weir, with hook and line from April 1 to Dec. 31. In Dist. 1¾, with hook and line from May 29 to Dec. 31; with spear from Aug. 1 to Oct. 31, bag limit 2 per day. In Dists. 2, 2¼, with hook and line from May 1 to Feb. last; with spear from Nov. 1 to Feb. last, bag limit 2 per day. In Dist. 3, with hook and line from May 1 to Oct. 31, bag limit 2 per day. In Klamath River Dist. above tidewater, with hook and line from May 29 to Dec. 31; with spear, from Aug. 1 to Oct. 31, bag limit 2 per day. In Klamath River Dist. in tidewater, with hook and line from May 29 to Dec. 31. Bag limit is 5 per day from May 29 to Sept. 3, and 2 per day from Sept. 4 to Dec. 31, and more than 1 daily bag limit in possession. In Dists. 6, 7, 8, 9 with hook and line from April 1 to Sept. 15, no bag limit. In Dists. 10, 11, with hook and line from May 1 to Aug. 31, no bag limit. In Dists. 12, 12B, 12C, 13, with hook and line at any time, no bag limit. In Dist. 12A, with hook and line from May 1 to Feb. last, bag limit 2 per day. In Dists. 15, 16, 17, 18, with hook and line from Mar. 1 to July 15.

LICENSES MUST BE SHOWN UPON DEMAND

Districts 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h, 1i, 1j, 1k, 1m, 1n, 1o, 1p, 1q, 1r, 1s, 1t, 2a, 2b, 3a, 3b, 3c, 3d, 3e, 3f, 3g, 3h, 4a, 4b, 4c, 4d, 4e, 4f, 4g, are Game Refuges. Hunting prohibited. Angling in accordance with law relating to main districts in which refuge is located.

Districts 5, 6, 7, 8, 9, 10, 11, 12, 12a, 12b, 12c, 13, 16, 17, 18, 19, 19a, 20, 20a, 21, 22, are Commercial Fishing Districts. Hunting and angling in accordance with law relating to main district in which small district is located.

District 14 is a Fish Reservation. All fishing prohibited.

District 2½ includes those townships in Mendocino County bordering on the Pacific Ocean (except 15 and 16 W., 11 N.) and townships 13, 14, 15, 16, 17 and 18 N., R. 16 W.

District 2¾. Those parts of Mendocino, Lake and Colusa counties lying east of the Redwood Highway and north of the Lake Tahoe-Uriah Highway, and all of Glenn County.

District 23. The water shed of Lake Tahoe and Truckee River, Rubicon and Little Rubicon above confluence. Water shed of American River and Silver Creek above confluence. Includes waters in water shed of Commines above mother lode highway bridge, waters of South Fork American River between Chili Bar Bridge and mouth of Silver Creek, the waters of the Carson, West Carson and all tributaries, Twin Lakes, Silver, Twin, Blue, Meadow, Wood, Winnemucca, Scott, Burnside Lake and all tributary streams and the drainage area of Webber Creek above mother lode highway bridge.

Sporting fishing licenses are required for the taking of the following fish and mollusks only: Trout, yellow-tail, marlin, broad bill swordfish, spearfish or black sea bass, albacore, barracuda, bonito, rock bass, California whiting (also known as croakers and surf fish), yellowfin, croakers, spotfin croakers, salmon, steelhead and other trout, chubs, whitefish, striped bass, black bass, perch, crappies, yellow bass, Pismo clams, abalones, and all varieties of crayfishes.

LICENSE PROVISIONS

HUNTING

License year July 1 to June 30

Residents under 18	$1.00
Resident citizens	2.00
Nonresident citizens	10.00
Declarant aliens	10.00
Other aliens	25.00

ANGLING

License year January 1 to December 31

Resident citizens	$2.00
Nonresident citizens	3.00
Aliens	5.00
Under 18 no license required	

TRAPPING

License year July 1 to June 30

Citizens	$1.00
Aliens	2.00
Under 18 no license required	

DEER TAG

License year January 1 to December 31

Everyone (2 tags)	$1.00

COMMERCIAL HUNTING CLUBS

License year July 1 to June 30

Citizens	$25.00
Aliens	100.00
Operators, citizens	5.00
Operators, aliens	25.00

For Laws in Full See Fish and Game Code

For Commercial Fish Laws See Commercial Abstract

For Information Regarding Fish or Game Write to the Division of Fish and Game

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Launch "Albacore,' Monterey
Launch "Shrapnel," Sacramento
Launch "Quinnat," San Rafael
Launch "Hunter," Vallejo
Launch "Rainbow," Walnut Grove
Launch "Silverside," Eureka

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